14-D

PREPRINT OF

STAIRS—RAILINGS

OF THE

ARCHITECTURAL METAL HANDBOOK

We acknowledge the assistance of
The American Institute of Architects in criticizing the subject matter
and form of presentation of this publication.

NATIONAL ASSOCIATION OF
ORNAMENTAL METAL MANUFACTURERS

A. I. A. FILE NO. 14-D

An ARCHITECTURAL METAL HANDBOOK, of which this booklet is to be a part, is being prepared by the NATIONAL ASSOCIATION OF ORNAMENTAL METAL MANUFACTURERS:

To *provide an authoritative guide for assistance in preparing plans and specifications of Architectural Metal.*

To *establish uniform standards of construction.*

To *define terms which have become commonly used in the industry.*

To *eliminate confusion between this and other allied industries.*

To *present advantages and promote uses of Architectural Metals.*

CONTENTS OF THE COMPLETE ARCHITECTURAL METAL HANDBOOK

PREFACE

THE INDUSTRY

Part I ARCHITECTURAL METALS
Composition and characteristics of ferrous and non-ferrous metals used in the Architectural Metal Industry.

Part II METAL WORKING TECHNIQUES
Methods of Fabrication.

Part III ARCHITECTURAL METAL PRODUCTS
Descriptions and drawings of metal items produced by the Architectural Metal Industry.

Part IV METAL PRODUCTS RELATED TO ARCHITECTURAL METAL
Metal products which should be specified separately from Architectural Metal.

Part V STRUCTURAL STEEL
Structural as related to Architectural Metal.

Part VI PAINTS AND FINISHES
Finishes, primers, lacquers, metallic protective coatings, mechanical finishes, and special finishes.

Part VII SPECIFICATIONS
Suggestions for the preparation of specifications. Code of standard practice.

Part VIII TABLES OF MATERIAL DATA
Data on sizes, gauges, and weights of metals.

GLOSSARY

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NATIONAL ASSOCIATION OF ORNAMENTAL METAL MANUFACTURERS

209 CEDAR AVENUE, TAKOMA PARK • WASHINGTON 12, D. C.

O. J. CONDON, Secretary

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PART III. PRODUCTS

Section 3—STAIRS

METAL STAIRS AND RAILINGS HAVE MANY ADVANTAGES IN THE DESIGN AND CONSTRUCTION OF A BUILDING, INCLUDING:

Adaptability—All types of buildings are benefited by the use of metal stairs properly constructed and arranged.

Variety of Design—The architect has great latitude in the design of strings, risers, platforms, newel posts, railings, facias, and wall rails, and also in the selection of metals and finishes, and in the material of treads and platforms.

Durability—Metal stairs will withstand the hardest usage, as metal will outlast many other materials, and will maintain its original appearance.

Fireproof—Metal stair construction is insurance against damage or failure in case of fire.

Strength—Metal stairs can be designed for adequate strength with a minimum of weight, insuring maximum efficiency. The assembled stair forms a solid structure, free from vibration.

Economy of Space—Due to their strength as related to size of members, metal stairs and supports occupy the minimum amount of building space.

Relocation—Metal stairs can be moved from one location to another during alterations or remodeling operations.

Low Maintenance—Metal stairs require a minimum of maintenance expense. Railings and wall rails, particularly of non-ferrous metal, require a minimum of care.

Erection—Metal stairs are easily assembled and simple to erect as they are completely fabricated in the shop. They may be erected with the framework of the building and thus placed into immediate service.

Cost—Metal stairs of standard construction compare favorably in cost with stairs of other material. In ornamental design, metal stairs occupy a unique position not attainable in other materials.

THIS SECTION SHOWS SEVERAL METHODS OF CONSTRUCTING METAL STAIRS AND RAILINGS. WHERE CONDITIONS REQUIRING OTHER TYPES OF CONSTRUCTION ARE MET, THE METHODS AND PRINCIPLES SHOWN HERE MAY BE VARIED OR AMPLIFIED. DESIGN, OTHER THAN STRUCTURAL, IS INDICATED ONLY WHERE INVOLVED IN STAIR CONSTRUCTION.

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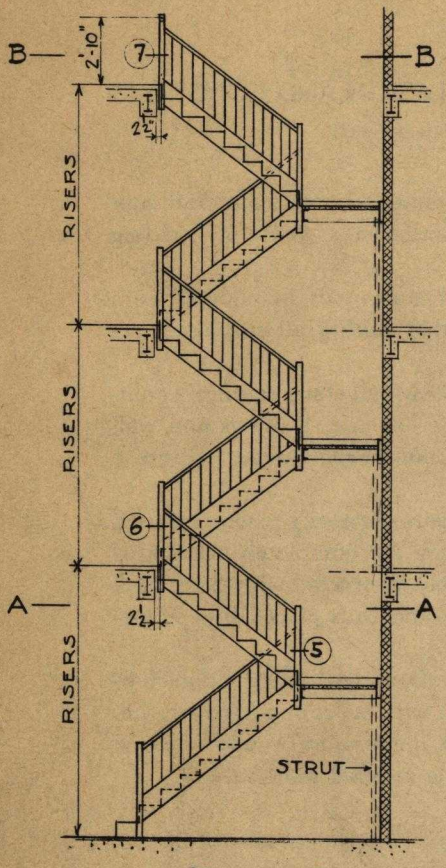
STAIRS

TYPE I. GENERAL PURPOSE



SECTION
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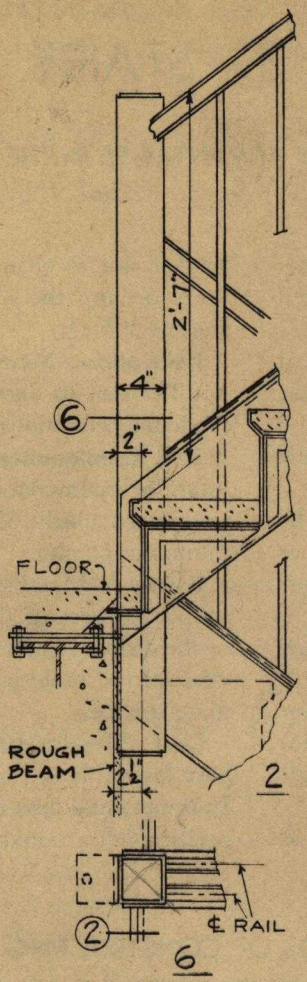

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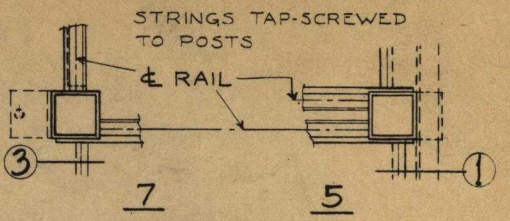

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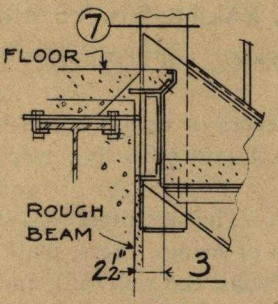

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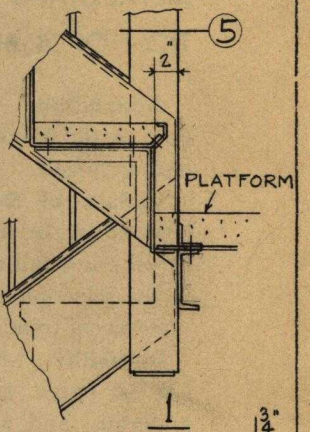

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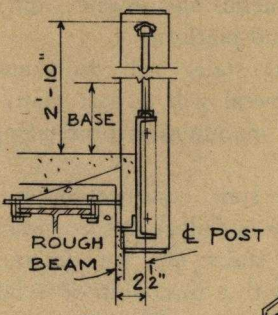

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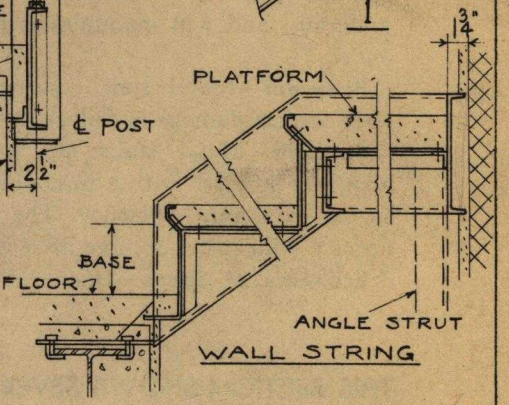
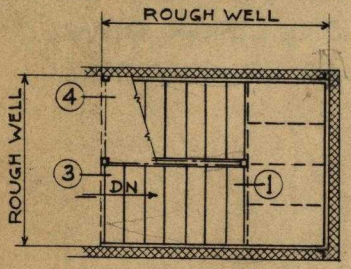
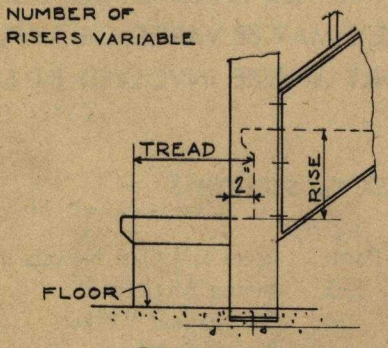


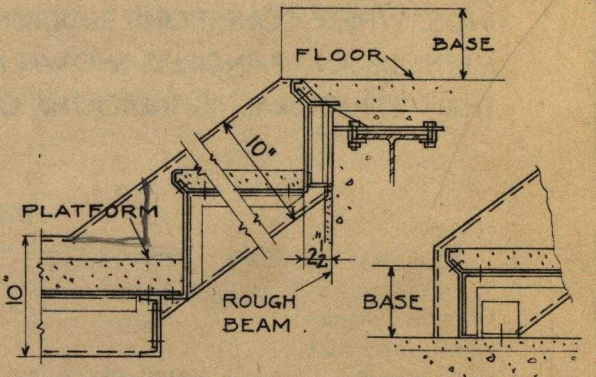
WALL STRING



PLAN B-B

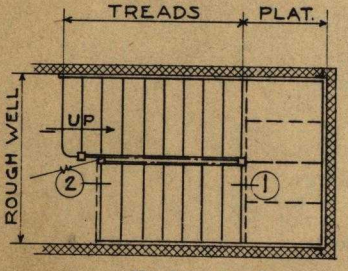


START-AT POST



WALL STRING START-AT WALL

SCALE 3/4"=1'-0"



PLAN A-A

Fig. 1

LAYOUT FOR:
MULTIPLE STORY
INTERMEDIATE PLATFORM
TWO RUNS PER STORY

SPECIFICATION FOR STAIR AS DETAILED:
Furnish and erect steel stairs and railings complete as detailed. Strings 10"x1½"x8.4 lb. channels with 1¼"x1¼"x⅛" angle brackets, facias same section bolted to newels and floor construction. Headers of channels bolted or welded to newels and strings. Angle struts placed in wall, bolted to strings and to floor construction. Risers and sub-treads of 14 gauge steel, sub-platforms of 12 gauge steel reinforced with angle or tee stiffeners. Fill, 2" for treads, 3" for platforms, by others. Newels 4" square pipe, railing balusters ½" square spaced 4½" and welded into 1"x½" channels top and bottom with handrail section as shown. All surfaces to be cleaned and painted one shop coat. Shop drawings, to show construction methods and fastenings, are to be approved before fabrication.

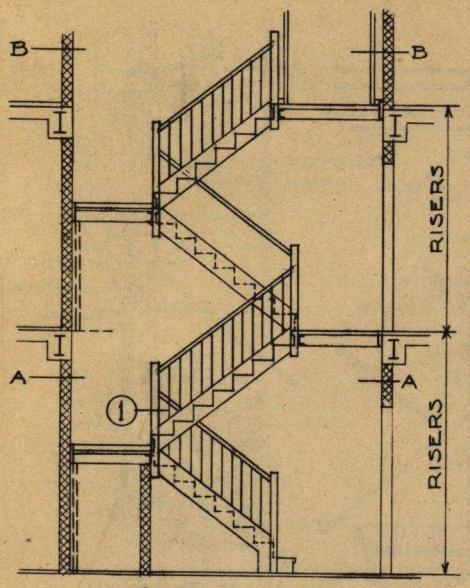
ALTERNATE SPECIFICATIONS:
Strings may be channels, flat plates, or formed plates. Pages 14 and 24.
Tread Brackets may be other size angles, or bars. Page 15.
Riser Brackets may be omitted.
Hanger Rods may be used in place of struts.
Sub-Treads, Risers and **Sub-Platforms** may be heavier gauge.
Newels and **Railings** may be of other construction as designed by architect.
Wall Rails, where required, may have same handrail section as railing. Pages 17 and 18.
Prime Coat may be red lead, black graphite, zinc chromate, or other approved paint.

Copies of pages 2, 4, 5, and 6 may be obtained in 17x22 size from the National Association of Ornamental Metal Manufacturers.

STAIRS

ADDITIONAL LAYOUTS FOR TYPE I STAIR

Type I construction is shown in steel, but non-ferrous metals may be used to advantage, especially for railings and wall rails. Newel posts, strings, string moldings, and treads and risers may also be designed in non-ferrous metals. Stainless steel is an effective material for railings on metal stairs.



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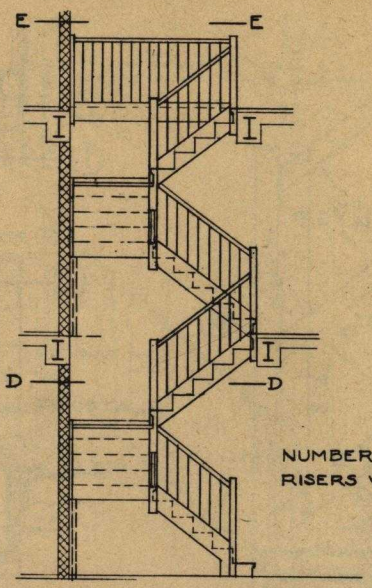

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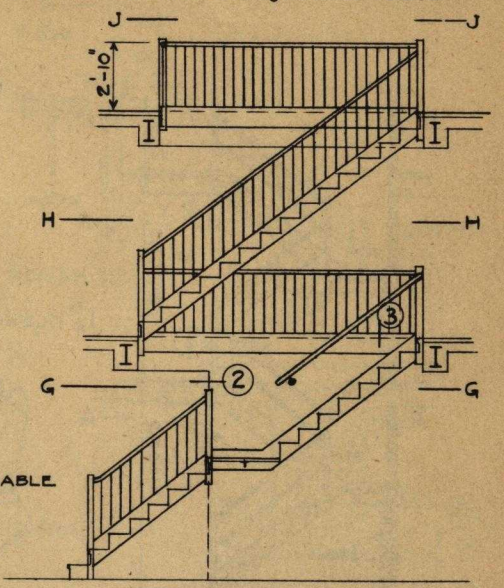

NUMBER OF RISERS VARIABLE

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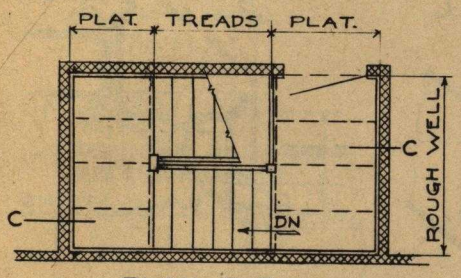
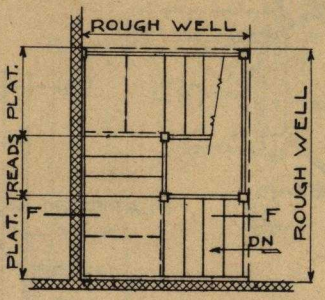


PLAN B-B



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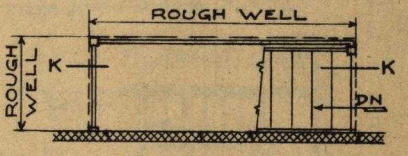

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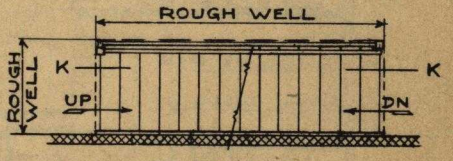

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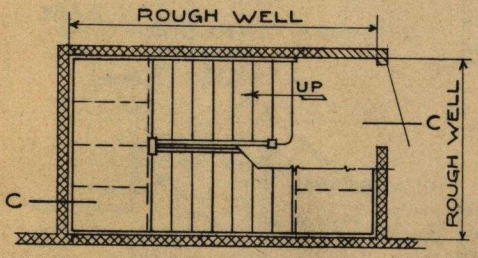
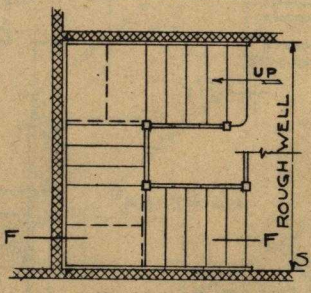


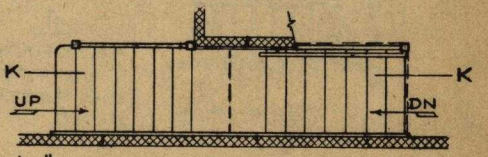
PLAN A-A

Fig. 2



PLAN D-D

Fig. 3



PLAN G-G

SCALE $\frac{1}{8}$" = 1'-0"

Fig. 4

LAYOUT FOR:
MULTIPLE STORY
INTERMEDIATE PLATFORMS
PLATFORM AT FLOOR
TWO RUNS PER STORY

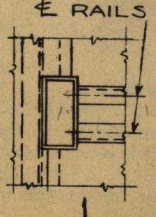
Strings and rails finishing against face of rectangular newels, allowing minimum hand clearance between strings and rails. For wider center well, two square newels replace one rectangular newel.

LAYOUT FOR:
MULTIPLE STORY
INTERMEDIATE PLATFORMS
THREE RUNS PER STORY

Open center well allowing intermediate stair runs at 90 degrees. One square newel at each platform.

LAYOUT FOR:
MULTIPLE STORY
INTERMEDIATE PLATFORMS
ONE AND TWO RUNS PER STORY

Arrangement for stairs in corridors, or other restricted spaces, either closed or open well.



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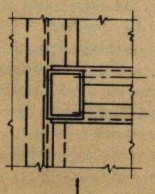
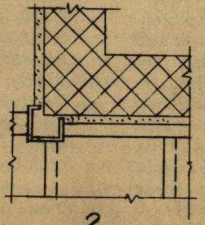


1 ALTERNATE



2

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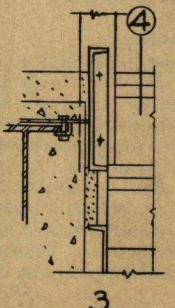

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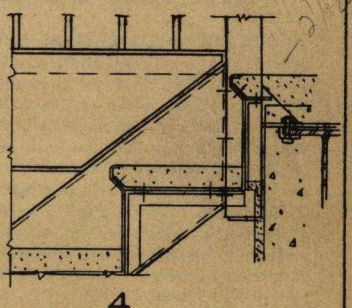


4

STAIRS

TYPE II. FOR SERVICE AND EXIT

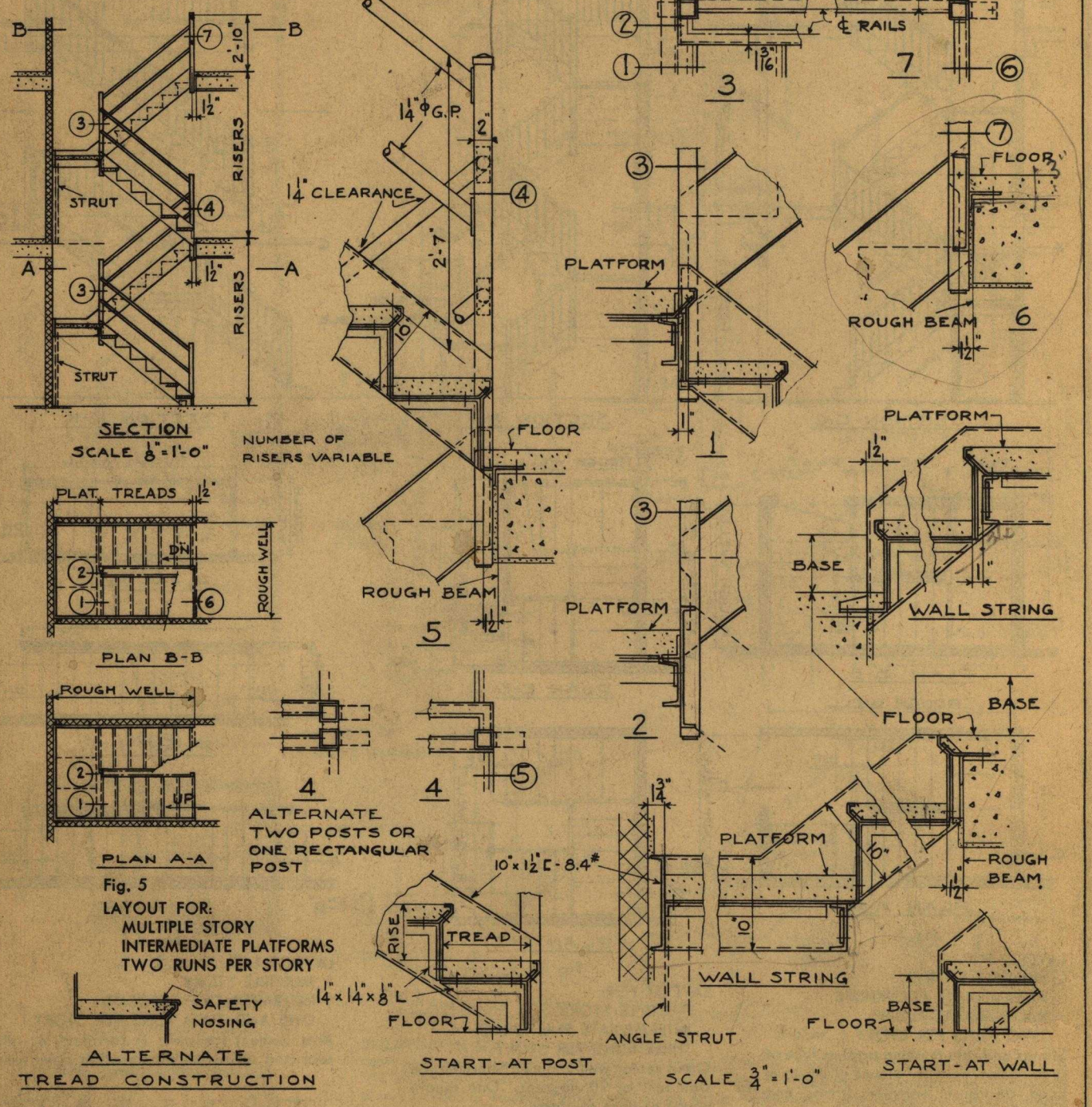


Fig. 5

LAYOUT FOR:
MULTIPLE STORY
INTERMEDIATE PLATFORMS
TWO RUNS PER STORY

SPECIFICATION FOR STAIR AS DETAILED:

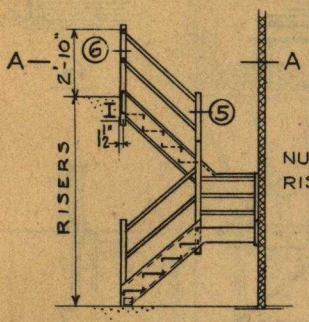
Furnish and erect steel stairs and railings complete as detailed. Strings 10"x1½"x8.4 lb. channels with 1¼"x1¼"x⅛" angle brackets. Facias same section bolted to newels and floor construction. Headers of channels bolted or welded to newels and strings. Angle struts placed in wall, bolted to strings and to floor construction. Risers and sub-treads of 14 gauge steel. Sub-platforms of 12 gauge steel reinforced with angle or tee stiffeners. Fill, 2" for treads, 3" for platforms, by others. Newels 2" square pipe. Railings 1¼" pipe with welded end plates bolted to newels. All surfaces to be cleaned and painted one shop coat. Shop drawings, to show construction methods and fastenings, are to be approved before fabrication.

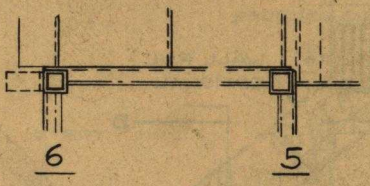
ALTERNATE SPECIFICATIONS:

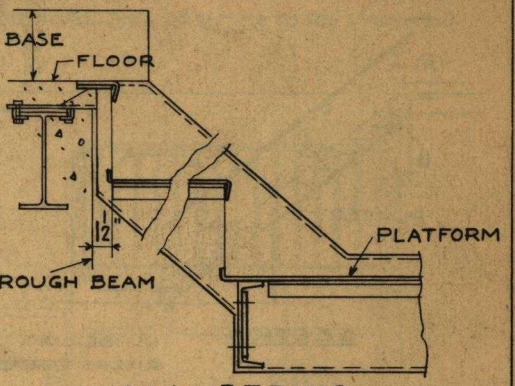
Strings may be channels, flat plates, or formed plates. Pages 14 and 24.
Safety Treads or **Nosings** of abrasive material may be used with tread fill.
Treads and **Platforms** may be cast metal, with or without abrasive.
Tread Brackets may be other size angles, or bars. Page 15.
Riser Brackets may be omitted.
Hanger Rods may be used in place of struts.
Sub-Treads, Risers and **Sub-Platforms** may be heavier gauge.
Newels and **Railings** may be of other construction as designed by architect.
Strings, Newels and **Railings** may be welded as unit, where conditions permit.
Wall Rails, where required, may be of pipe with wall brackets or with ends returned to plates bolted to wall. Page 18.
Prime Coat may be red lead, black graphite, zinc chromate, or other approved paint.

STAIRS

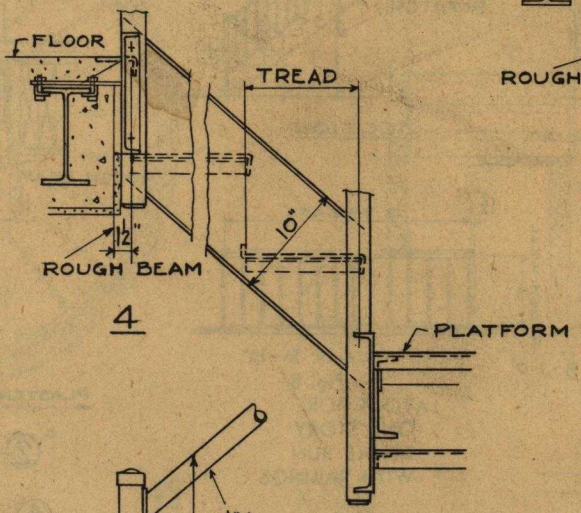
TYPE III. FOR INDUSTRIAL, POWER HOUSE, AND SIMILAR BUILDINGS

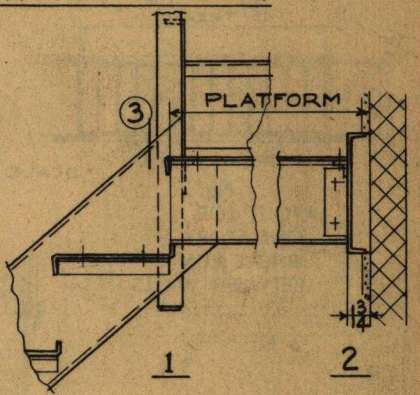






WALL STRING





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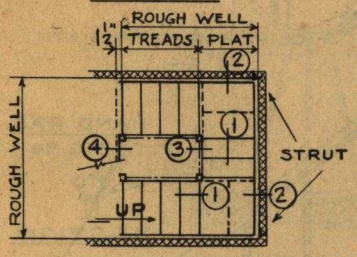
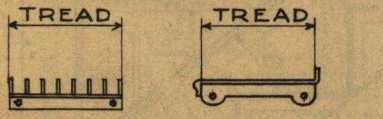


PLAN A-A

Fig. 6

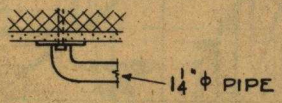
SCALE 8 = 1'-0"

LAYOUT FOR:
SINGLE STORY
INTERMEDIATE PLATFORMS
THREE RUNS PER STORY

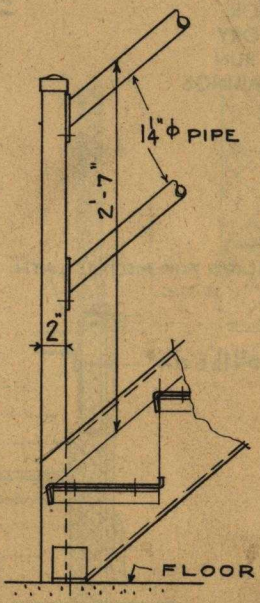


GRATING CAST ABRASIVE

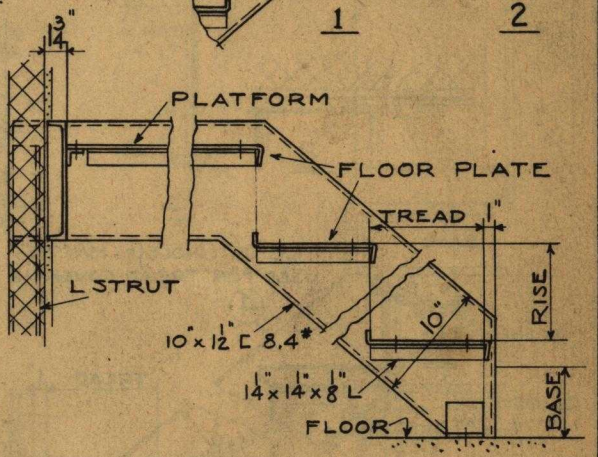
ALTERNATE
TREAD CONSTRUCTION



WALL RAIL
ENDS RETURNED

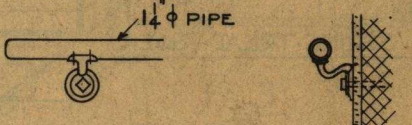


START-AT POST



WALL STRING

SCALE ¾" = 1'-0"



WALL RAIL
CLOSED END WITH BRACKET

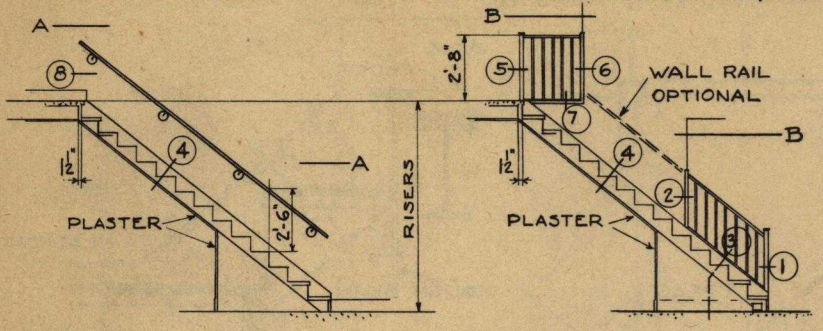
SPECIFICATION FOR STAIR AS DETAILED:
Furnish and erect steel stairs and railings complete as detailed. Strings 10"x1½"x8.4 lb. channels with 1¼"x1¼"x⅛" angle brackets, facias same section bolted to newels and floor construction. Headers of channels bolted or welded to newels and strings. Angle struts placed in wall, bolted to strings and to floor construction. Treads of 3/16" floor plate with formed nosing and turned-up back edge as shown. Platforms of 3/16" floor plate bolted to strings and headers, and reinforced as shown with angle or tee stiffeners, with formed nosing and turned-up open edges. Newels 2" square pipe, railings 1¼" pipe with welded end plates bolted to newels. All surfaces to be cleaned and painted one shop coat. Shop drawings, to show construction methods and fastenings, are to be approved before fabrication.

ALTERNATE SPECIFICATIONS:
Strings may be channels, flat plates or formed plates. Pages 14 and 24.
Floor Plate thickness may be varied to suit stair width.
Treads and **Platforms** may be of gratings or cast metal with or without abrasive.
Tread Brackets may be other size angles, or bars. Page 15.
Hanger Rods may be used in place of struts.
Newels and **Railings** may be of other construction.
Strings, Newels and **Railings** may be welded as unit, where conditions permit.
Wall Rails, where required, may be of pipe with wall brackets or with ends returned to plates bolted to wall. Page 18.
Prime Coat may be red lead, black graphite, zinc chromate, or other approved paint.

Copies of pages 2, 4, 5, and 6 may be obtained in 17x22 size from the National Association of Ornamental Metal Manufacturers.

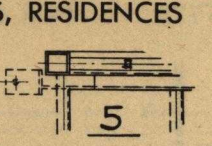
STAIRS

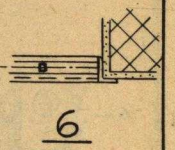
TYPE IV. FOR HOUSING PROJECTS, APARTMENTS, RESIDENCES

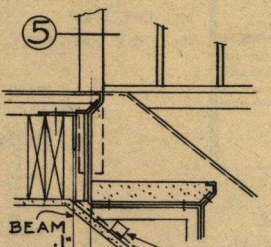


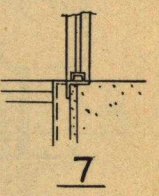
SECTION SECTION

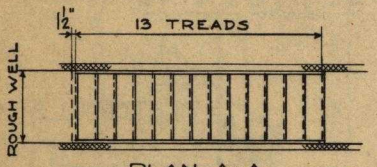
NUMBER OF RISERS VARIABLE







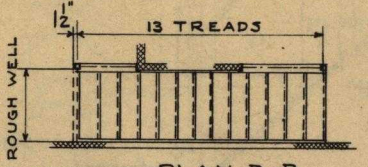




PLAN A-A

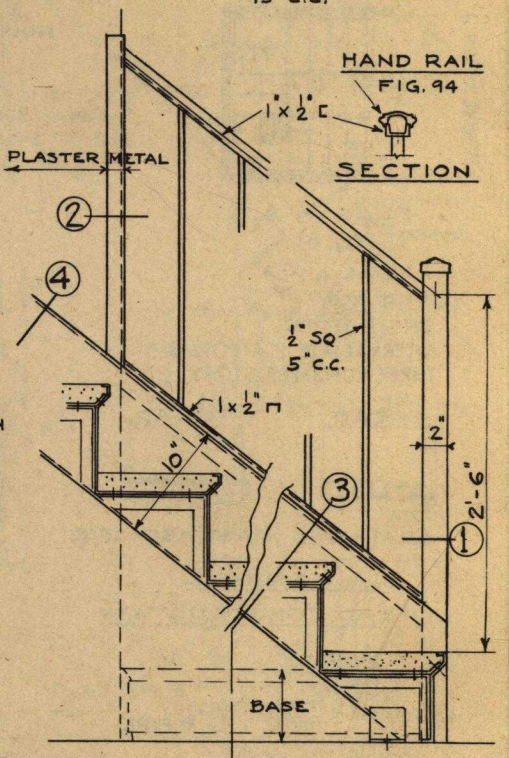
Fig. 7
LAYOUT FOR:
ONE STORY
SINGLE RUN
BETWEEN WALLS

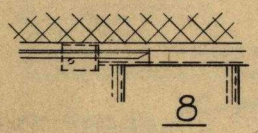
SCALE 1/8" = 1'-0"

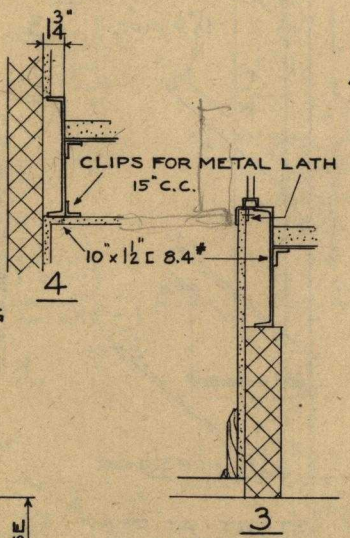


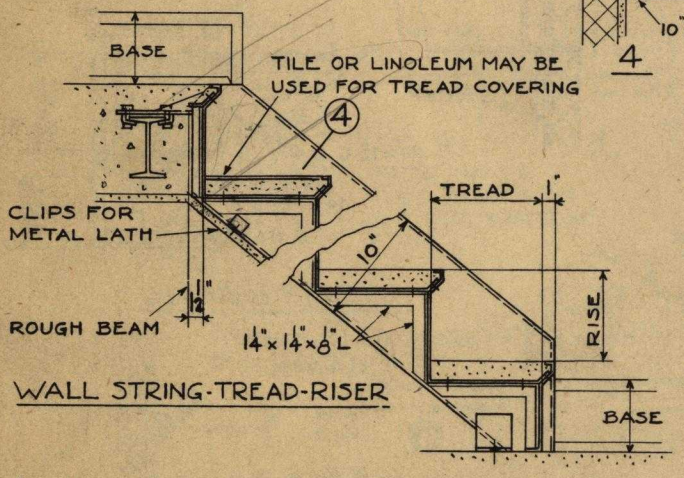
PLAN B-B

Fig. 8
LAYOUT FOR:
ONE STORY
SINGLE RUN
WITH RAILINGS

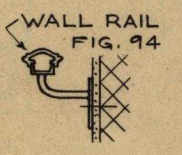


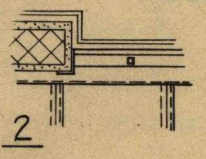


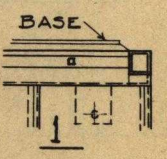


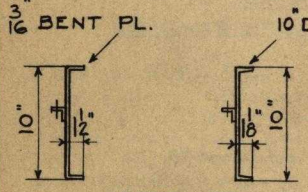


WALL STRING-TREAD-RISER



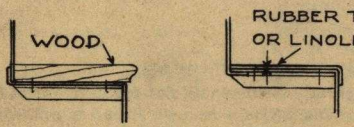






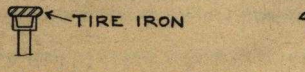
ALTERNATE STRING CONSTRUCTION

SCALE 3/4" = 1'-0"



ALTERNATE TREAD CONSTRUCTION

SUPPORTING BRACKETS ARE OMITTED WHEN TREADS ARE WELDED TO STRINGS



ALTERNATE RAIL CONSTRUCTION

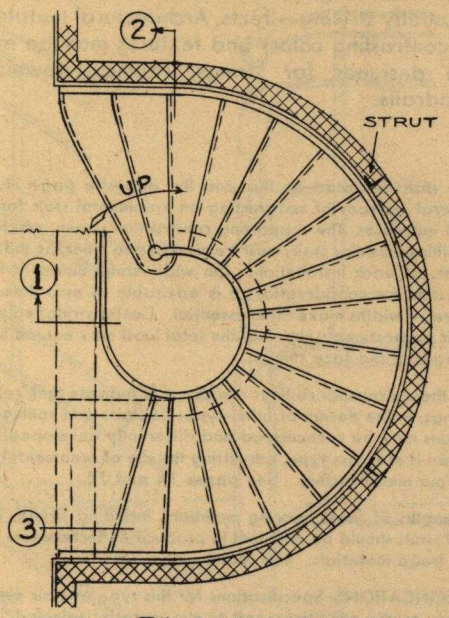
SPECIFICATION FOR STAIR AS DETAILED:
Furnish and erect steel stairs and railings complete as detailed. Strings 10"x1½"x8.4 lb. channels with 1¼"x1¼"x⅛" angle brackets. Risers and sub-treads of 14 gauge steel. Tread fill, 1½" by others. Newels 2" square pipe, balusters ½" square 5" c.c. welded to 1"x½"x⅛" channels bottom and top with cap of rolled section as shown. Wall rail 1"x½"x⅛" channel with cap and brackets as shown. Shop drawings to show construction methods and fastenings, are to be approved before fabrication. All surfaces to be cleaned and painted one shop coat. Metal lath for plastered soffit furnished by others.

Copies of pages 2, 4, 5, and 6 may be obtained in 17x22 size from the National Association of Ornamental Metal Manufacturers.

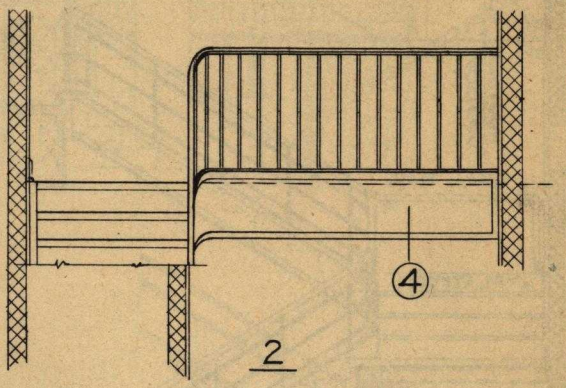
STAIRS

TYPE V. CIRCULAR STAIRS

Circular stairs may be employed very effectively in homes, libraries, clubs, and other private and public buildings where this unusual architectural feature may add its distinctive appearance and its particular type of service to the structure.



PLAN A-A



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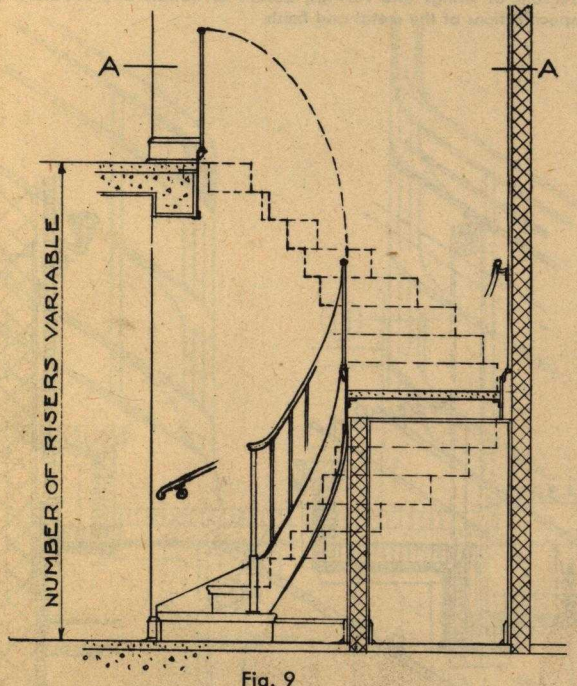
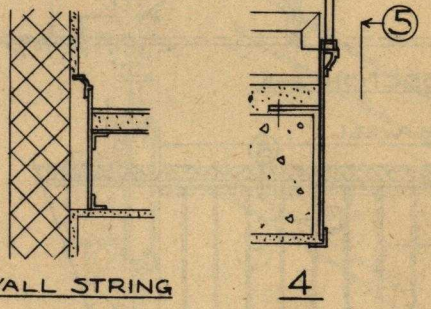


Fig. 9

1

SCALE $\frac{1}{4}$"=1'-0"



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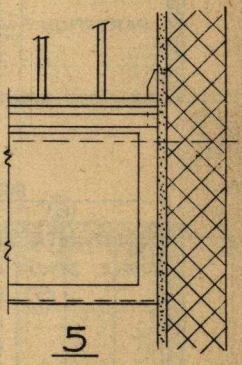

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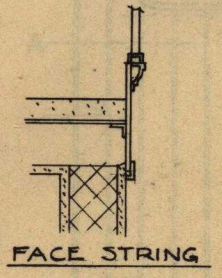
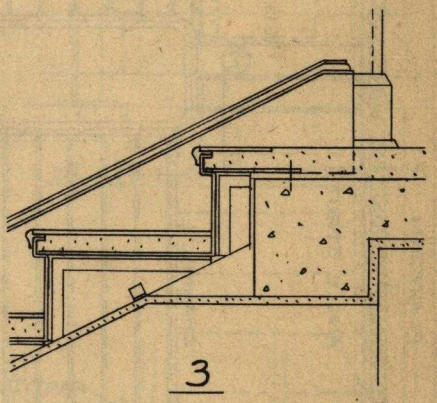




3

SCALE $\frac{3}{4}$"=1'-0"

Circular stairs placed between walls may be built self-supporting at the inner string and be supported by concealed struts or hangers at the outer string. When completely exposed a circular stair may be designed to require few supports between floors.

In constructing a circular stair the overall size of the well and the tread length of the stairs may be adjusted to fit the particular conditions of the structure. Treads should be a minimum width of 8" at a distance 15" out from the inside railing. The treads may be of steel, abrasive cast iron, abrasive nonferrous metal, cement, tile, linoleum, wood, marble or other material.

Landings and platforms may be constructed as part of the stair, and may be supported by beam or cantilever construction. Wall rails and brackets may be constructed with handrail sections matching the railing.

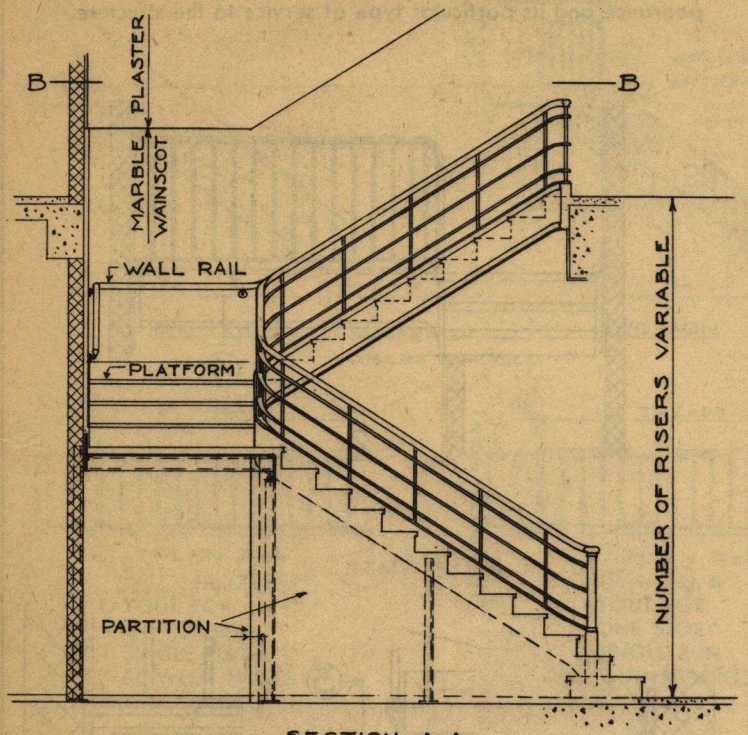
Face strings and railings may be similar to those used on straight stairs but should be designed of shapes adaptable to abrupt curved construction. The small radius to which these are constructed offers possibilities of design that should not be overlooked. Combinations of contrasting metal colors can be effectively employed in such installations.

SPECIFICATIONS: Specifications for this type of stair must be written to apply to the conditions and to the material selected. It is important to prepare plans and elevations, indicating the structural supports, sections of strings and railings, details of newels and brackets, and specifications of the metal and finish.

STAIRS

TYPE VI. FOR LOBBIES AND ENTRANCES

Stairs of steel combined with marble or other material for public buildings lend themselves to many beautiful and unusually striking effects. Architectural metals in matching or contrasting colors and textures may be employed by the designer for strings, railings, newels and wall handrails.



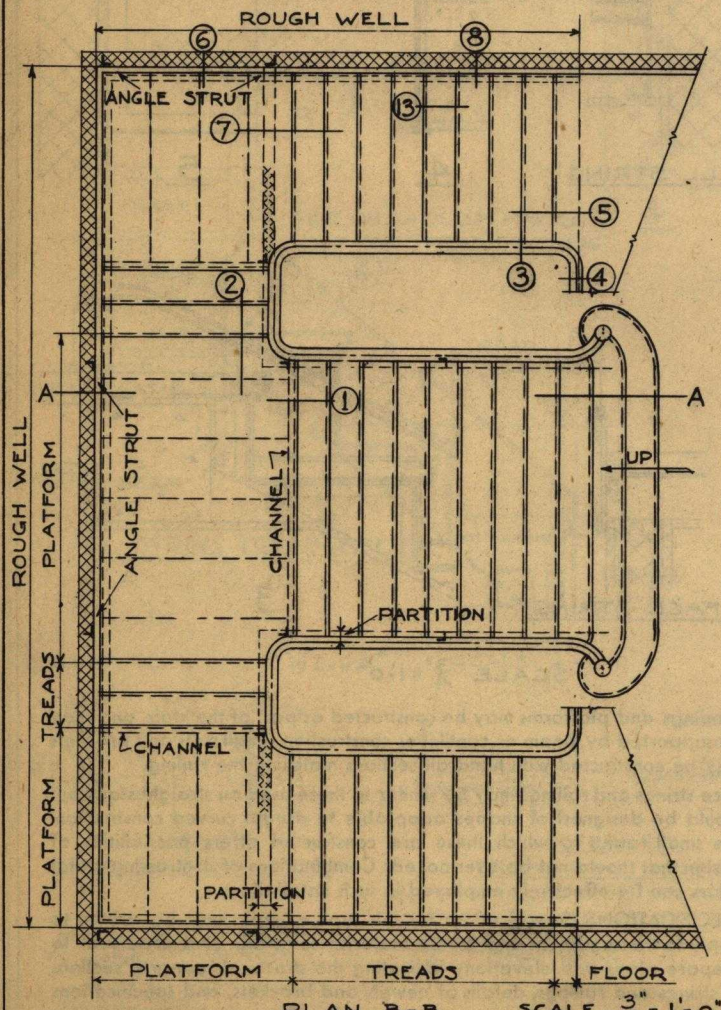
SECTION A-A

The stair indicated on this and the opposite page illustrates one of several methods of constructing an ornamental stair for public lobbies and entrances. The supporting construction shown, which is satisfactory for this particular stair, must be modified to meet the individual requirements of each installation. On wide stairs center strings may be a question for consideration; it is advisable to omit them except where extreme widths make them essential. Center strings calculated to carry their proportionate share of the total load may extend below the lower flanges of the face strings.

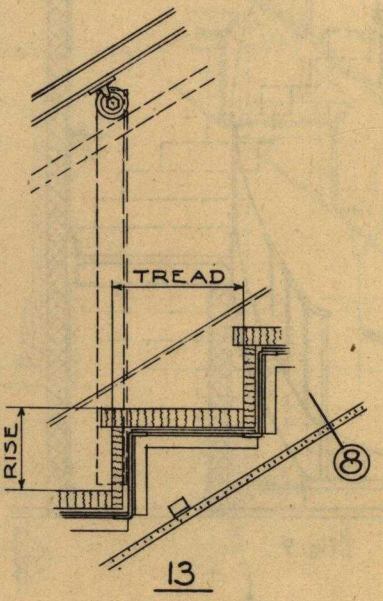
On these drawings railings are shown to indicate their relationship to the strings; in the design of other types of stairs and railings different conditions may be encountered and differently developed. The face string shown is of a box type, permitting the use of ornamental ferrous or non-ferrous metal facings. See pages 14 and 15.

Strengths of load bearing members, including strings, risers, headers, and struts should be sufficient to produce deflections less than critical for the tread materials. See tables page 24.

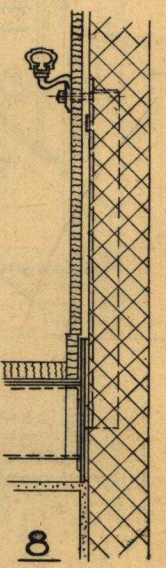
SPECIFICATIONS: Specifications for this type of stair must be written to apply to the conditions and to the material selected. It is important to prepare plans and elevations, indicating the structural supports, sections of strings and railings, details of newels and brackets, and specifications of the metal and finish.



PLAN B-B SCALE $\frac{3}{16}$" = 1'-0"



13



8

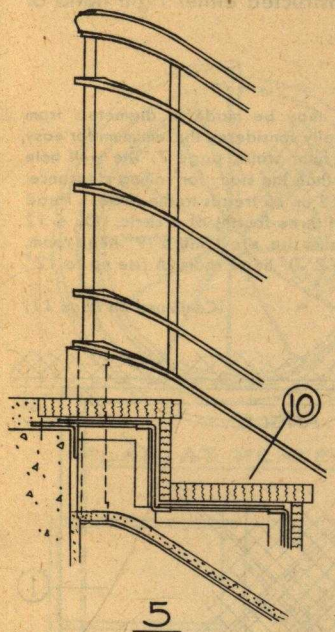
Wall rail brackets fastened to steel posts placed in wall and supported on wall string, with tie bar spacer. For use where marble or other wainscot material is not of sufficient strength by itself to carry the wall rail. This will insure that the required holes are drilled by the marble erector.

FOR DETAILS SEE PAGE 9

Fig. 10

STAIRS

TYPE VI. FOR LOBBIES AND ENTRANCES



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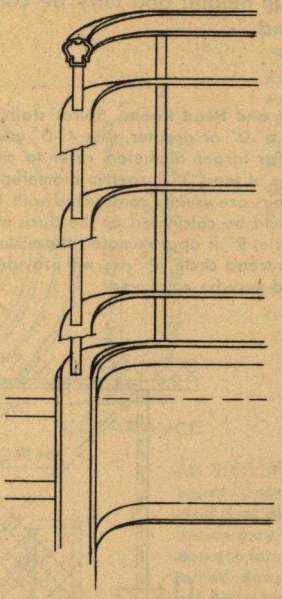

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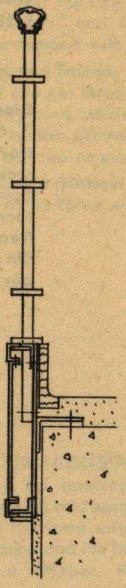

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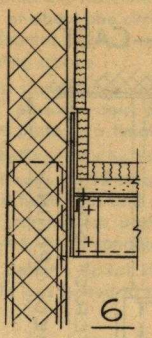

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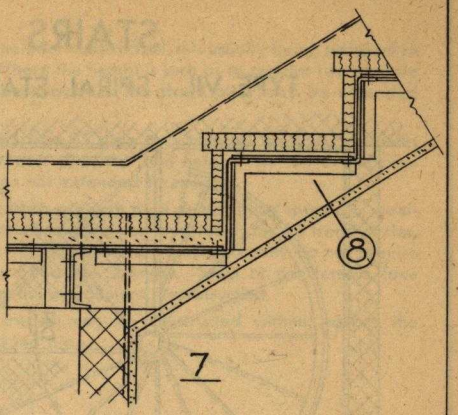

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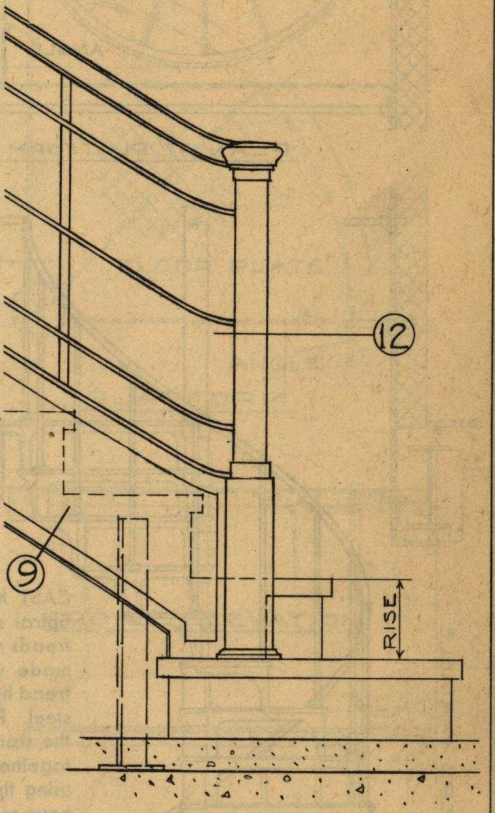
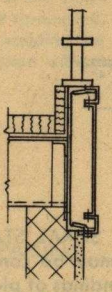


ELEVATION AT START



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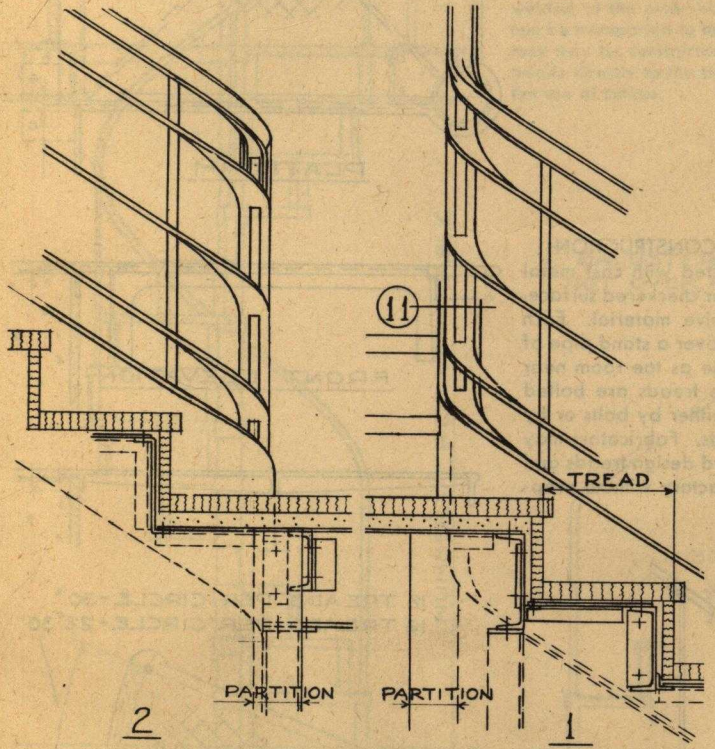
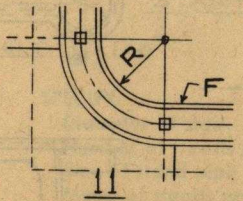


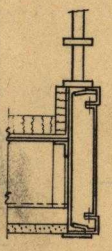
2

1

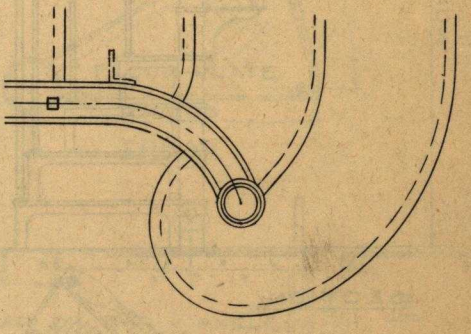


11

To maintain uniform pitch of stair at the face of string molding F, where the risers are on the spring line and 90° to each other, R should equal .637 times the tread. $R = \frac{2 \times \text{tread}}{3.1416}$



10



12

SCALE $\frac{3}{4}$" = 1'-0"

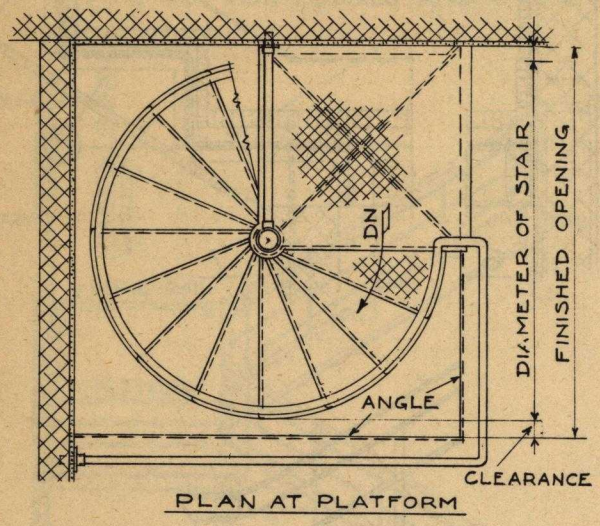
STAIRS

TYPE VII. SPIRAL STAIR—CAST

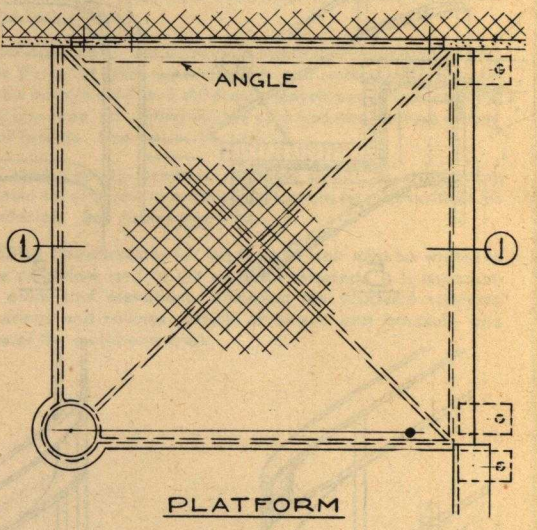
Spiral stairs are adapted for use in gymnasiums, power plants, pumping stations, vaults and other places where floor space may be limited. They may be placed in a corner, adjacent to a wall, or out in the open. They may extend several stories in height, and may be constructed either right hand or left hand.

Diameter and Head Room: Spiral stairs may be made in diameters from 3'-6" to 6'-0" or greater, with 4'-0" usually considered the minimum for easy travel. For larger diameters refer to circular stairs, page 7. The well hole should be at least 3" larger in diameter than the stair, for railing clearance. Spiral stairs are usually constructed with 12 or 16 treads to the circle. Head room should be calculated on the basis of three-fourths of a circle. On a 12 tread circle, 9" is approximately the minimum rise, providing 6'-9" head room. On a 16 tread circle, 7" rise will provide 7'-0" head room. A rise up to 12" per tread may be employed.

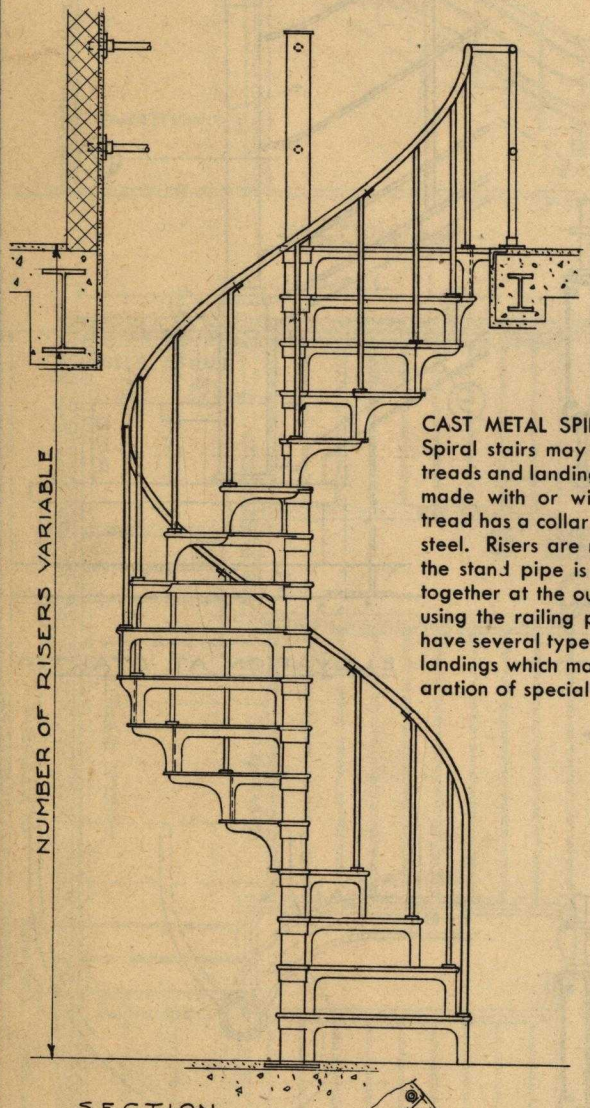
(Continued on Page 11)



PLAN AT PLATFORM



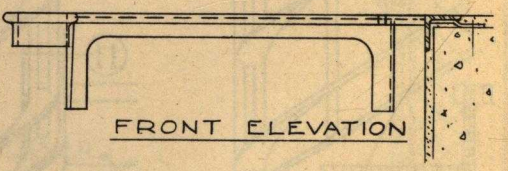
PLATFORM



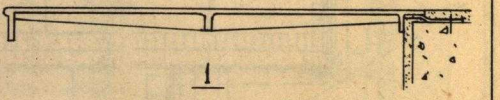
SECTION

Fig. 11

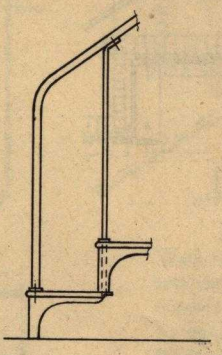
CAST METAL SPIRAL STAIR CONSTRUCTION: Spiral stairs may be constructed with cast metal treads and landings of plain or checkered surface, made with or without abrasive material. Each tread has a collar which slips over a stand pipe of steel. Risers are not desirable as toe room near the stand pipe is limited. The treads are bolted together at the outer edge, either by bolts or by using the railing posts as bolts. Fabricators may have several types of standard design treads and landings which may be satisfactory without preparation of special patterns.



FRONT ELEVATION

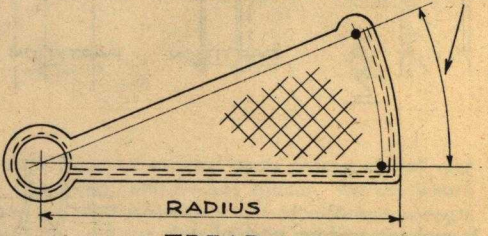


1

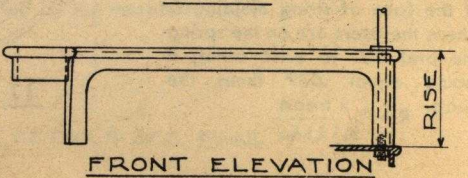


START

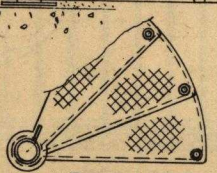
12 TREADS PER CIRCLE - 30°
16 TREADS PER CIRCLE - 22°30'



TREAD



FRONT ELEVATION



PLAN AT START

SCALE $\frac{3}{8}$" = 1'-0"

SCALE $\frac{3}{4}$" = 1'-0"

STAIRS

TYPE VIII. SPIRAL STAIR—STEEL

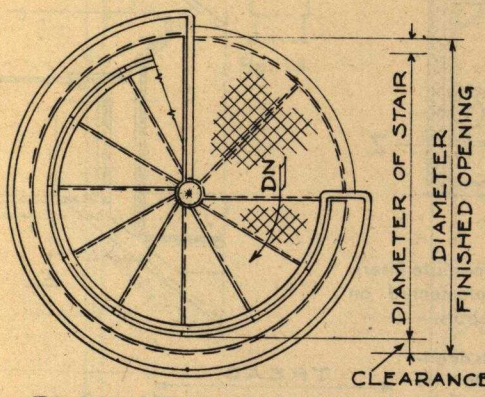
(Continued from Page 10)

Bracing: Landing platforms are fastened to the floor construction, this usually being sufficient to properly brace a stair of about one circle. Where the height is such as to require two or more circles, additional horizontal bracing must be provided. The stand pipe may be extended and secured to the ceiling above.

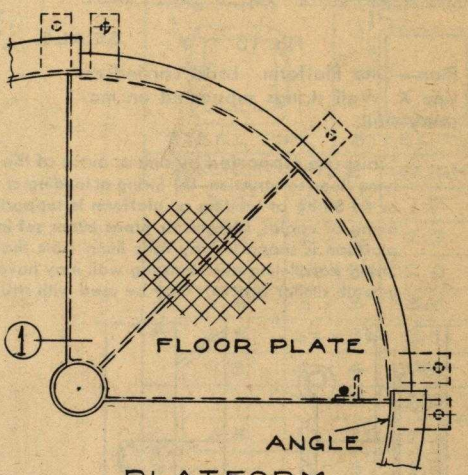
Stand Pipes: The size of stand pipes may vary from 3" pipe as a minimum for 4'-0" diameter stairs, to 3½" and 4" pipe for stairs of greater diameter and height. The top of the pipe may be capped with a plate or a finial when not extended to ceiling.

Railings and Strings: Railings may be of pipe top rail with pipe or bar posts spaced a maximum of one per three treads for 12 tread circles and one per four treads for 16 tread circles. They may have molded hand rails and ornamental balusters. Railings usually do not require braces as the circular construction provides adequate strength. Steel or non-ferrous face strings may be employed where conditions require ornamental construction.

Construction Without Collars: Spiral stair treads may be constructed without collars, the treads being fitted with lugs bolted to the stand pipe.

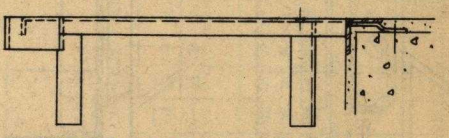


PLAN AT PLATFORM

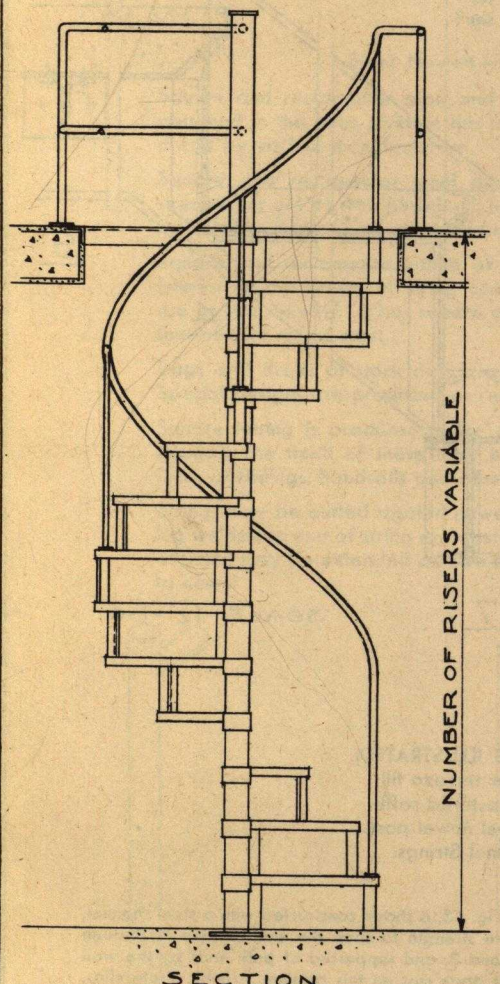


PLATFORM

ALL STEEL SPIRAL STAIR CONSTRUCTION: Spiral stairs may be constructed with steel floor plate treads and landings. The treads may have the front edge turned down to form a nosing and the back edge turned down for a stiffener. Risers are not desirable as toe room near the stand pipe is limited. Steel treads are welded to a steel collar fitting over the stand pipe, and have a support and a stiffener welded at the outer edge. If the stairs can be transported to the site assembled, they may be constructed by welding the treads directly to the stand pipe without the use of collars.

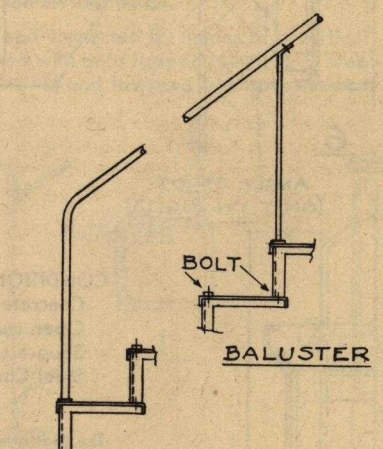


FRONT ELEVATION



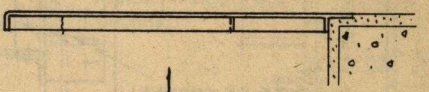
SECTION

BALUSTER SPACING NOT OVER 90°



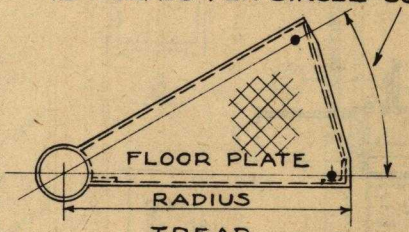
BALUSTER

START



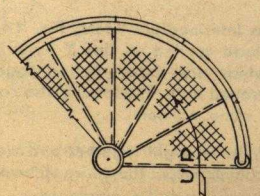
1

16 TREADS PER CIRCLE - 22°30'
12 TREADS PER CIRCLE - 30°



TREAD

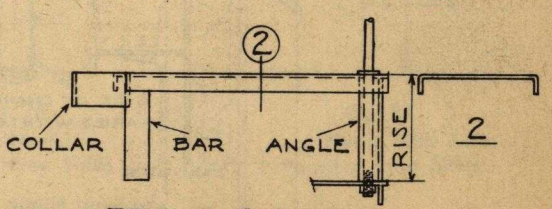
Fig. 12 SCALE $\frac{3}{8}$" = 1'-0"



PLAN AT START

SPECIFY:

- Diameter of stair.
- Number of treads per circle.
- Size of stand pipe and treatment at top.
- Metal of treads and platform.
- Size and design of hand rail and balusters.
- Provide detail of special treads, ornamental railings, or strings.



2

FRONT ELEVATION

SCALE $\frac{3}{4}$" = 1'-0"

STAIRS

PLATFORM CONSTRUCTION

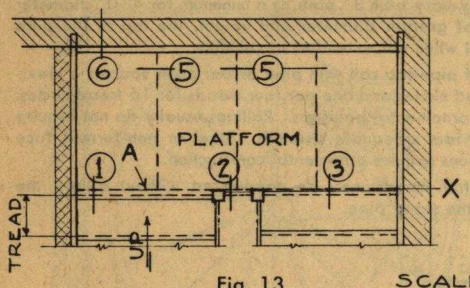
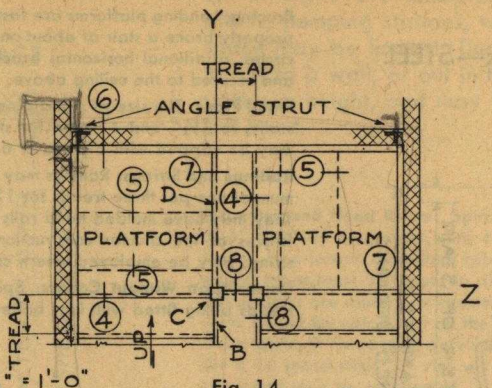


Fig. 13

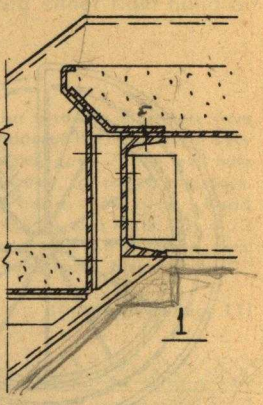
Plan—One Platform. Load carried on Line X. Wall strings supported on masonry wall.



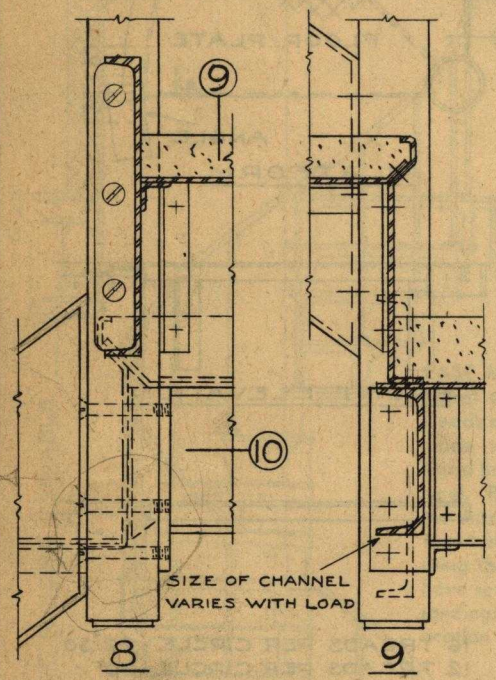
SCALE $\frac{1}{4}$" = 1'-0"

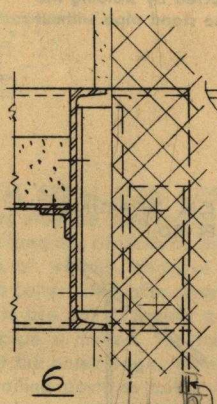
Fig. 14

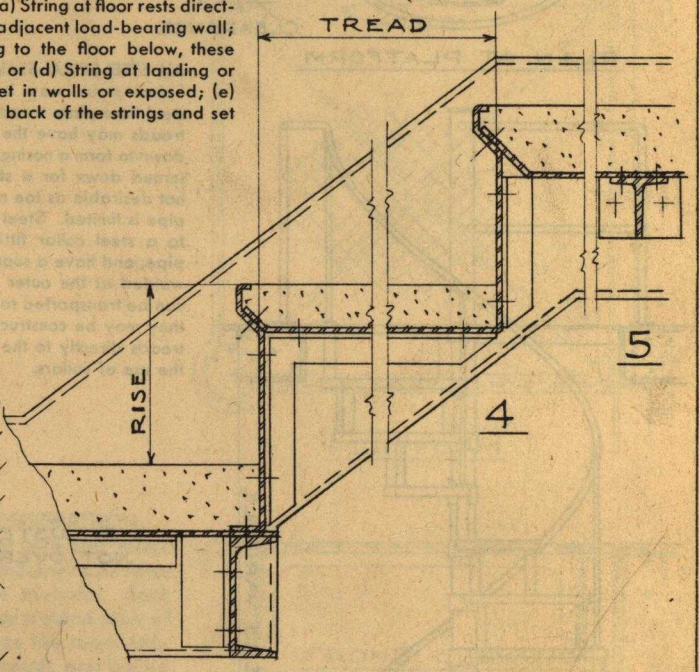
Plan—Two Platforms with Two Intermediate Risers. Load carried on Line Y and supplemented on Line Z. Wall strings supported by struts.



Stairs are supported by one or more of the following methods, (a) String at floor rests directly on floor construction; (b) String at landing or platform extends into adjacent load-bearing wall; or (c) String at landing or platform is supported by struts extending to the floor below, these being of angles, I-beams or pipes either set in the wall or exposed; or (d) String at landing or platform is supported by rods hung from the floor above, either set in walls or exposed; (e) String paralleling load-bearing wall may have shelf brackets on the back of the strings and set in wall; similar brackets may be used with struts or hanger rods.

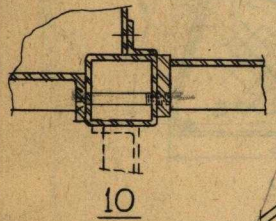


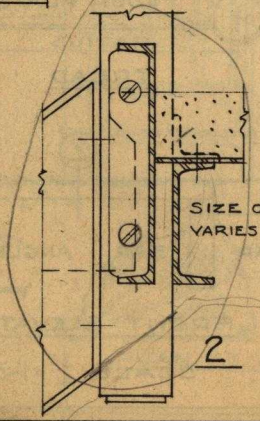


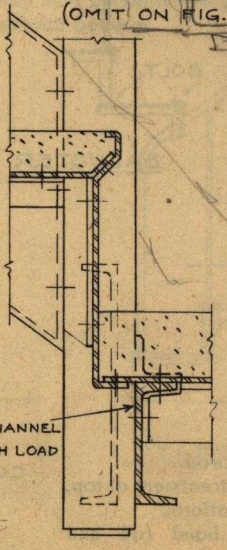


SCALE 1$\frac{1}{2}$" = 1'-0"

ANGLE STRUT (OMIT ON FIG. 13)







CONDITIONS ILLUSTRATED:

Concrete or terrazo fill.
Open unplastered soffit.
Square steel newel posts.
Steel Channel Strings.

The platform, Fig. 13, is shown constructed with a steel channel, A, of adequate strength to span the well on Line X, through Sections 1, 2 and 3, and supported at both ends by the wall strings. Newel posts rest on this channel through angle clips, around which the platform plate is cut, Section 3. Face strings have welded end plates with flathead screws tapped into the newels, Section 2.

The two platforms with two intermediate risers, Fig. 14, are shown constructed with the load carried on Line Y by string B, post C and channel D, which are shown bolted together, Sections 8, 9 and 10, with through bolts. The load is also carried from post C on line Z in the same manner.

The members at post C may be brought together and welded and the post fitted over the connection, or the entire unit welded.

STAIRS

STEEL AND CAST NEWELS

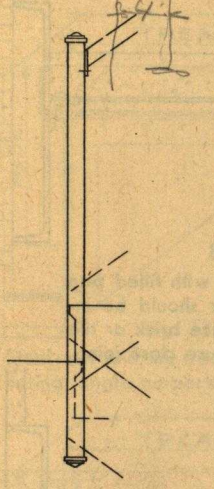


Fig. 15

Fig. 18

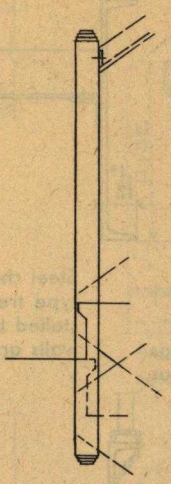


Fig. 16

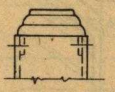


Fig. 19

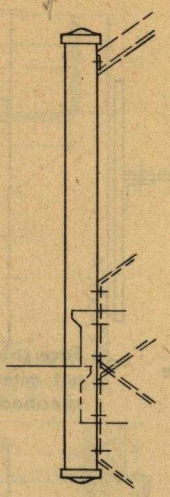


Fig. 17

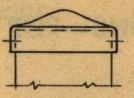


Fig. 20

Steel Newels—Caps—Drops

Square and rectangular pipe and tubing for use as newel posts may be obtained in the sizes given in this table, and in other sizes as may be produced by various manufacturers.

Square and rectangular steel pipe of 3/16" wall thickness has sufficient strength for use as stair newels. It has rounded corners, and its surface finish is similar to that of hot rolled mild steel.

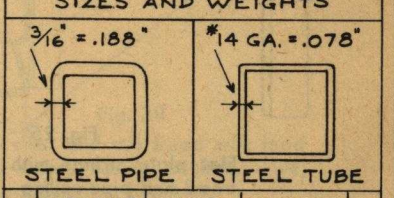
Square and rectangular tubing of No. 14 or other gauge usually requires interior reinforcement at string connections to insure sufficient strength for use as stair newels. It has square corners, and its surface finish is similar to that of cold rolled steel.

Caps and drops of stock design are available in cast or pressed metal. Special designs are produced as required.

Square tubing is produced in the non-ferrous metals in several sizes and gauges. The finish of these may be made to match or contrast with the finish of railings, handrails and other non-ferrous metal.

Strings may be butted against newel and connected by means of a vertical lug welded to end of string and fastened with bolts tapped to newel, or web of string may be extended on side of newel and fastened with bolts tapped to newel.

SQUARE PIPE AND TUBE
SIZES AND WEIGHTS



	WEIGHT	SIZE	WEIGHT	
SQUARE	3.0	1½ x 1½	1.7	SQUARE
	4.5	2 x 2	2.3	
	5.6	2½ x 2½	2.8	
	7.6	3 x 3	3.4	
	8.5	3½ x 3½	3.9	
	9.8	4 x 4	4.5	
RECTANGULAR	3.9	1½ x 2	2.0	RECTANGULAR
	4.5	1½ x 2½	2.3	
		1½ x 3	2.6	
		1½ x 3½	2.9	
	5.6	2 x 3	2.9	
	7.6	2 x 4	3.5	
	9.8	3 x 5		
	10.2	3 x 6		
	13.1	3 x 8		
	11.9	4 x 6		
	14.4	4 x 8		

Sizes are outside dimensions in inches. Weights are approximate in pounds.

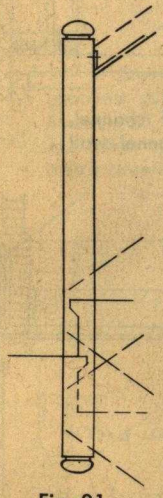


Fig. 21
Cast Newel
Plain

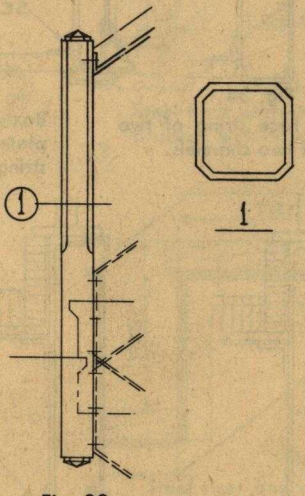


Fig. 22
Cast Newel
Chamfered Corners

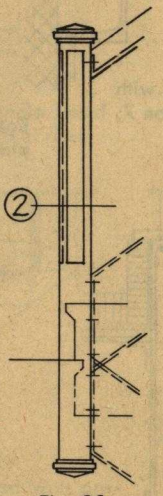
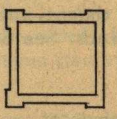


Fig. 23
Cast Newel
Panelled Free Sides



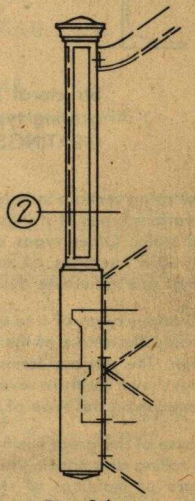


Fig. 24
Cast Newel with Base
Panelled Free Sides

Newel posts of cast metal may be manufactured in any shape, length and design required, with matching caps and drops. Economy may be achieved by the use of stock patterns. The advantage of special patterns lies in the variety of design that may be employed. String connections are similar to those used for steel newels.

SCALE 1" = 1'-0"

STAIRS

STRING SECTIONS—FOR ALL TYPES OF STAIRS

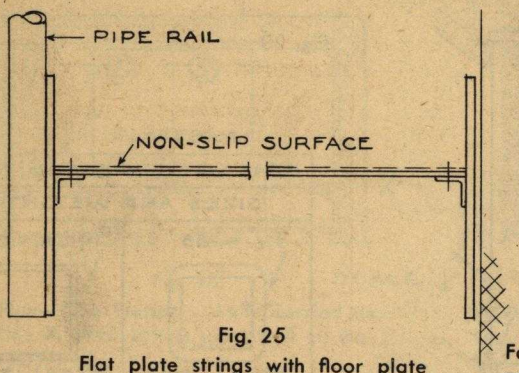


Fig. 25
Flat plate strings with floor plate tread and pipe railing.

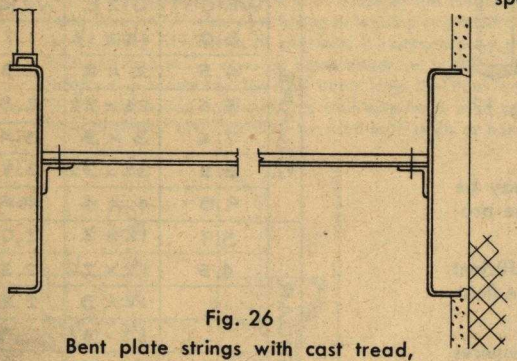


Fig. 26
Bent plate strings with cast tread, with or without abrasive.

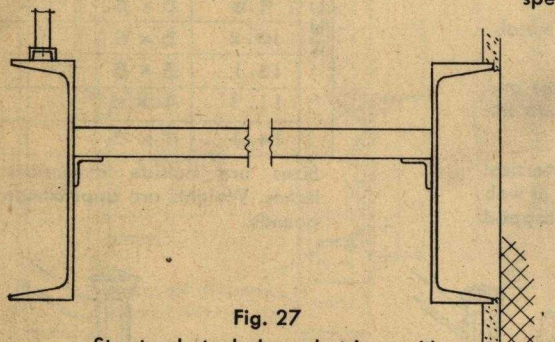


Fig. 27
Structural steel channel strings with grating type treads. See Section 7, GRATINGS.

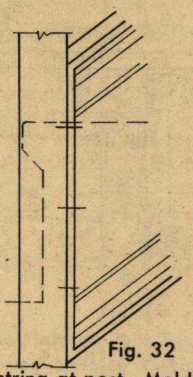


Fig. 32
Face string at post. Moldings not mitered unless shown or specified mitered.

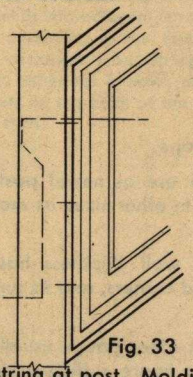


Fig. 33
Face string at post. Moldings mitered only when shown or specified mitered.

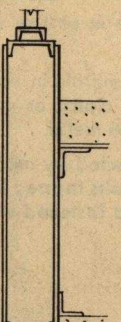


Fig. 34
Box type face string of two plates and two channels.

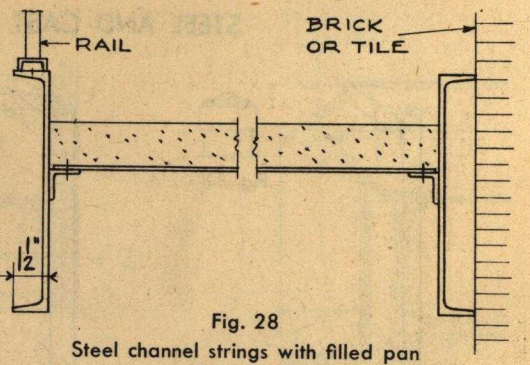


Fig. 28
Steel channel strings with filled pan type tread. The stair should be installed before the face brick or tile walls are built to insure close joints.

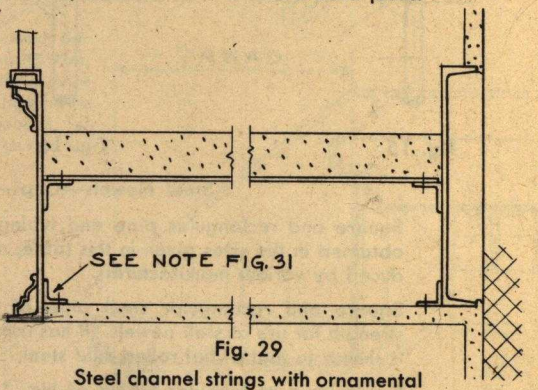


Fig. 29
Steel channel strings with ornamental molding on face string and channel wall string; plastered soffit.

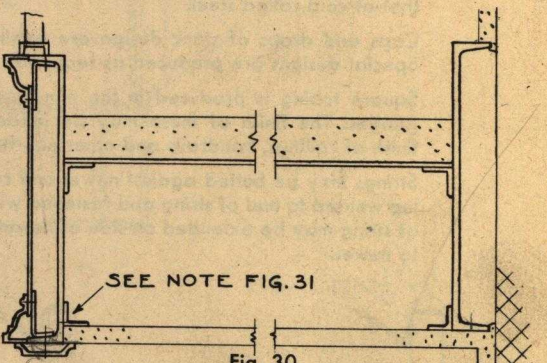


Fig. 30
Box type face string of channel, plate and moldings; channel wall string.

These string sections include a majority of the various types of strings employed for steel stairs. Other types also are used, and other methods of combining with railings are sometimes desired.

The various types of trim moldings shown are only illustrative of the possibilities of design. The various forms of box type strings shown illustrate several methods of accomplishing this type of construction.

Because of the great number of extrusion and rolling dies now in use for the manufacture of moldings of steel, aluminum, bronze and other metals, the architectural plans should give the manufacturers molding numbers selected. If the moldings shown are designed specially for the project the plans should so state.

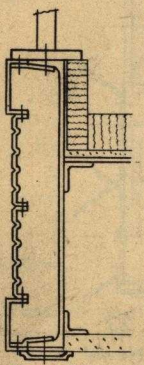


Fig. 35

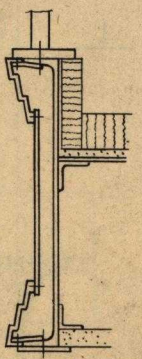


Fig. 36

Box type face strings.

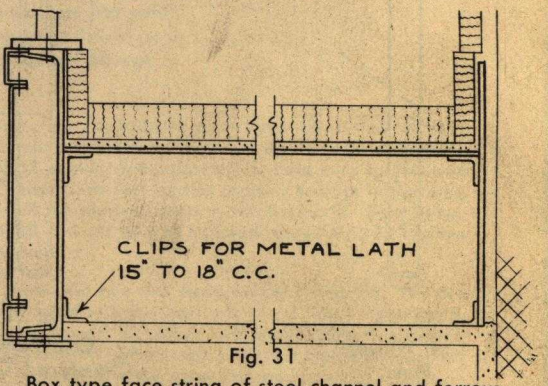


Fig. 31
Box type face string of steel channel and ferrous or non-ferrous exposed face; steel plate wall string.

SCALE $1\frac{1}{2}$" = 1'-0"

For sizes of strings and allowable uniform loads see table, page 24.

STAIRS

TREADS AND RISERS—FOR ALL TYPES OF STAIRS

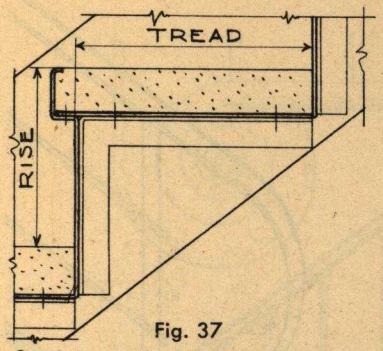


Fig. 37
Steel riser and sub tread with formed nosing, angle supporting brackets.

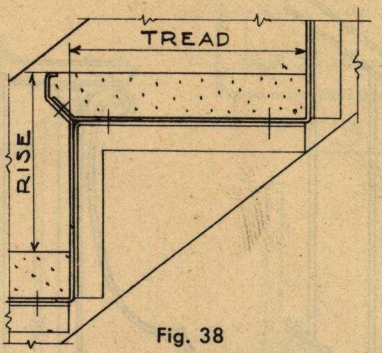


Fig. 38
Steel riser and sub tread with formed nosing, angle supporting brackets.

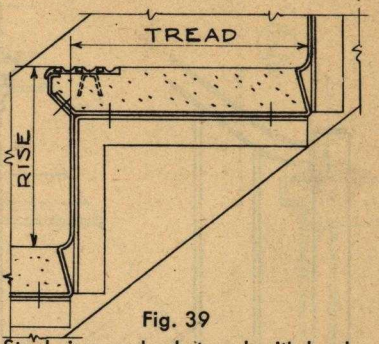


Fig. 39
Steel riser and sub tread with lead filled safety nosing, sanitary cove, angle supporting brackets.

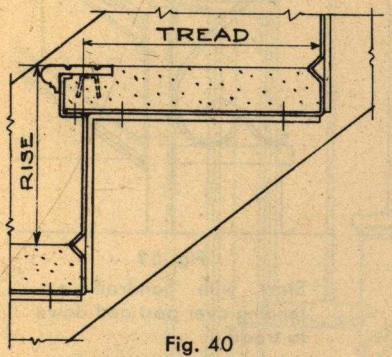


Fig. 40
Steel riser and sub tread with abrasive safety nosing, sanitary cove, flat bar supporting brackets.

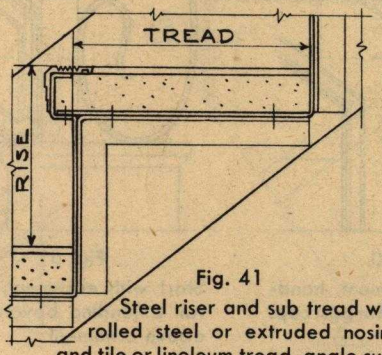


Fig. 41
Steel riser and sub tread with rolled steel or extruded nosing and tile or linoleum tread, angle supporting brackets. Other types of safety nosing or tread covering may be used.

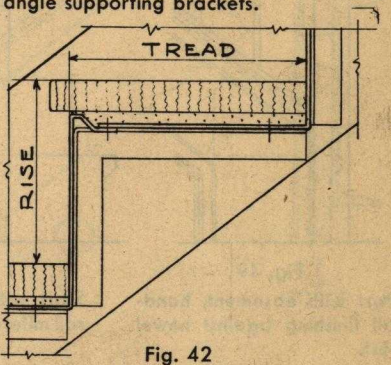


Fig. 42
Steel riser and sub tread with marble, or pre-cast tread, angle supporting brackets.

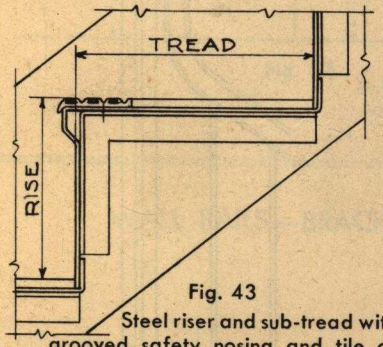


Fig. 43
Steel riser and sub-tread with grooved safety nosing and tile or linoleum fill, angle supporting bracket. Other types of safety nosing or tread covering may be used.

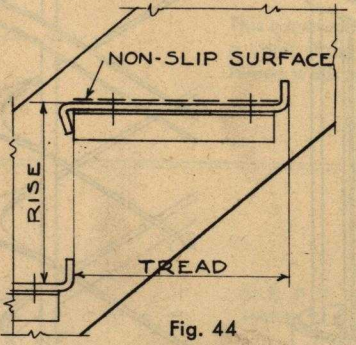


Fig. 44
Steel floor plate tread, angle tread bracket, with or without steel riser.

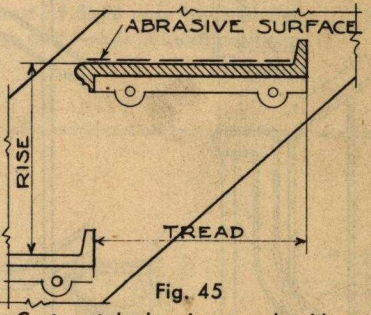


Fig. 45
Cast metal abrasive tread, with or without steel riser.

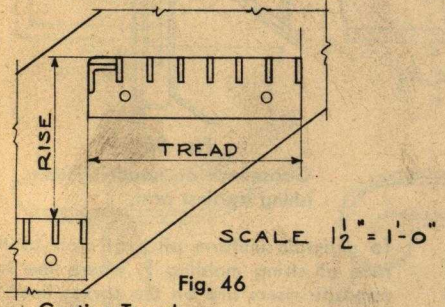


Fig. 46
Grating Tread.
See Section 7, GRATINGS.

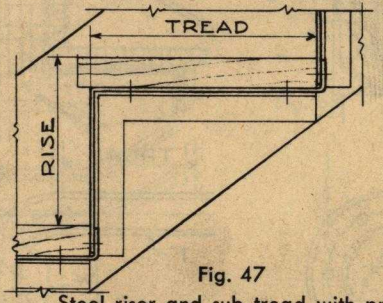


Fig. 47
Steel riser and sub tread with pre-cast or wood treads, angle supporting brackets.

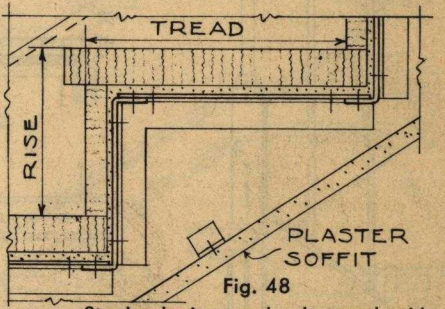


Fig. 48
Steel sub-riser and sub tread with marble tread and riser, angle supporting brackets.

Stairs with concrete or terrazzo fill may be constructed with the top of supporting bracket 2" below the tread surface and 3" below the platform surface. These thicknesses may be less for narrow stairs or where use is limited.

Fill is always considered the distance from string bracket to finish tread.

Treads and riser brackets may be 1¼"x1¼"x3/16" or ⅛" angles, welded or riveted to string, or ¼"x1¼" bar welded. Treads and risers are usually bolted to brackets with round head bolts. Cast or grating treads are usually bolted to strings with two ⅜" bolts at each end. Brackets back of risers may be omitted when more economical construction is desired. See page 23 for rise and tread dimensions.

SCALE 1½"=1'-0"

STAIRS

STARTS—EASEMENTS—GOOSENECKS—TURNS

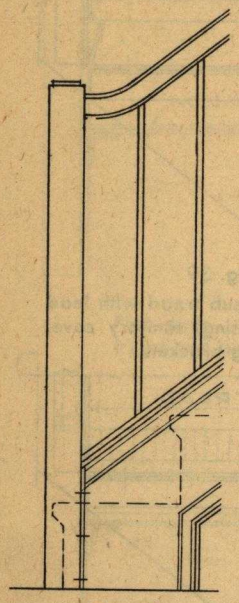


Fig. 49
Start with easement, handrail finishing against newel post.

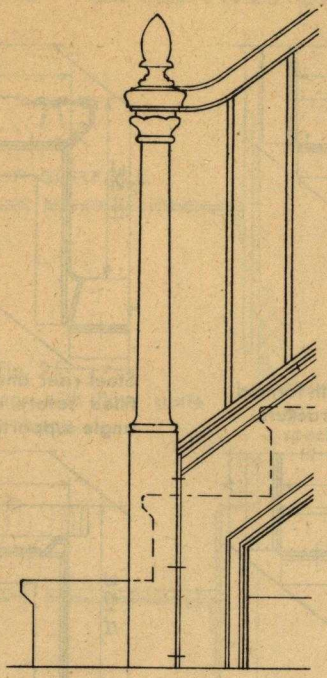


Fig. 50
Start with easement, handrail mitered to form post cap.

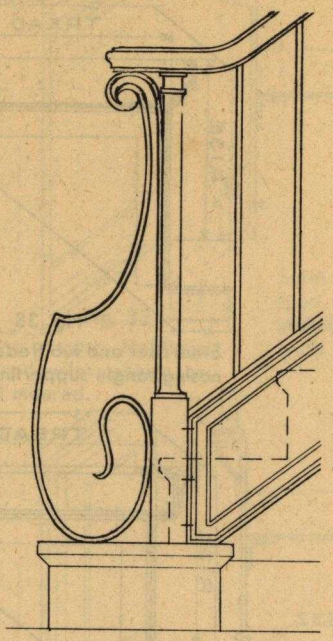


Fig. 51
Start with easement, handrail extending beyond post above ornament.

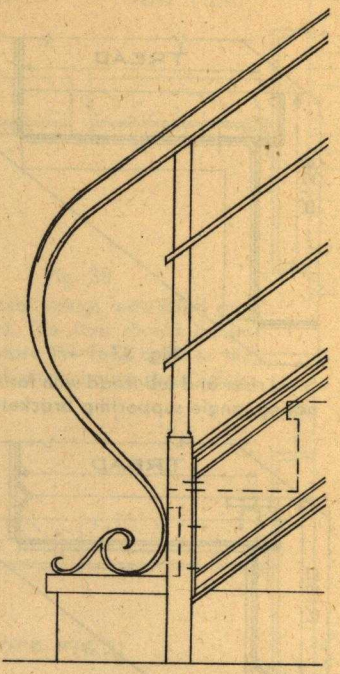


Fig. 52
Start with handrail extending over post and down to tread.

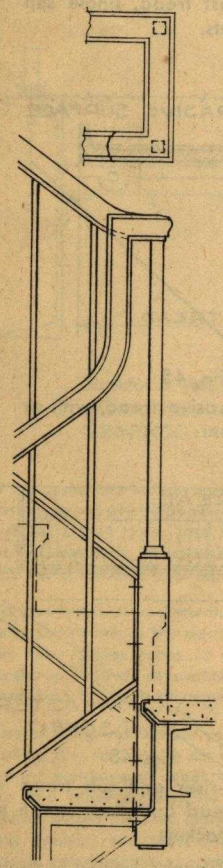


Fig. 53
Return with gooseneck and easements on continuous handrail.

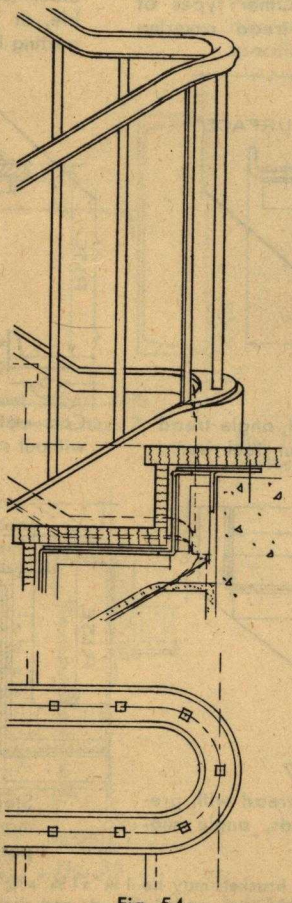


Fig. 54
Return with curved continuous handrail and easement.

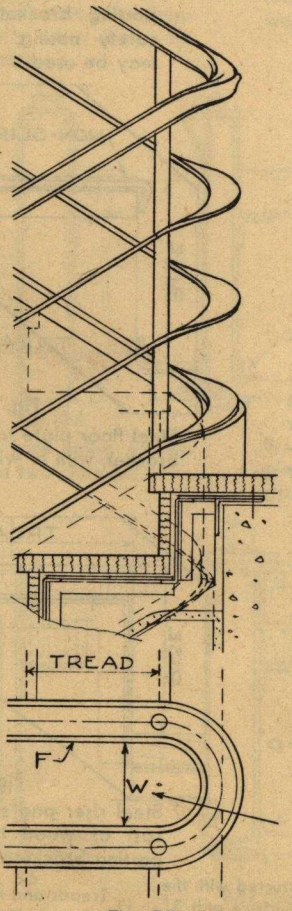


Fig. 55
Return with curved continuous handrail.

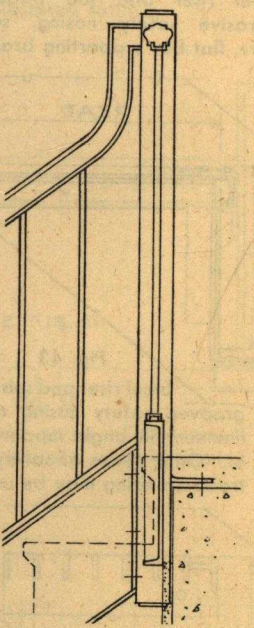


Fig. 56
Gooseneck on handrail finishing against post.

To maintain uniform pitch of stair at the face of string molding F, where the two opposite risers are on the spring line, W is .637 times the tread.

$$W = \frac{2 \times \text{tread}}{3.1416}$$

For other types of similar curved construction, W should be sufficient to allow for forming the string moldings without causing undue distortion.

SCALE $\frac{3}{4}$" = 1'-0"

STAIRS

START WITH OPEN END TREADS

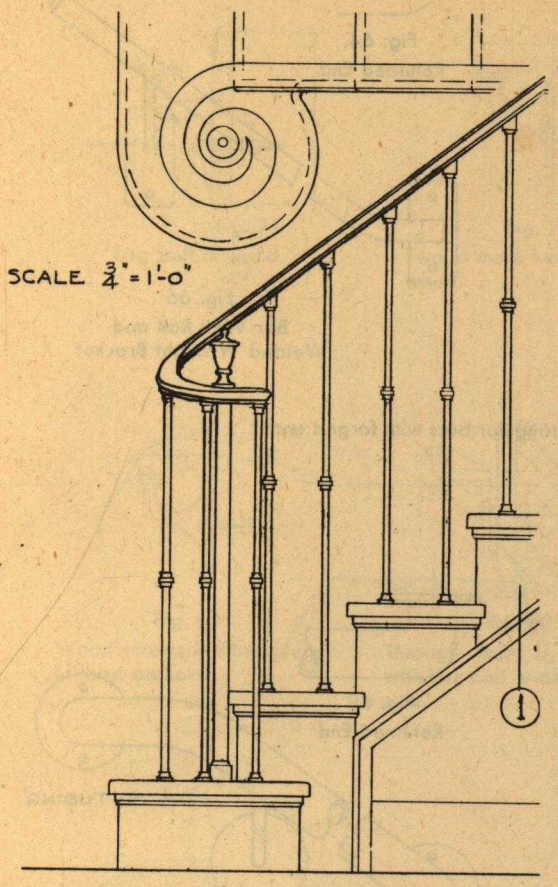
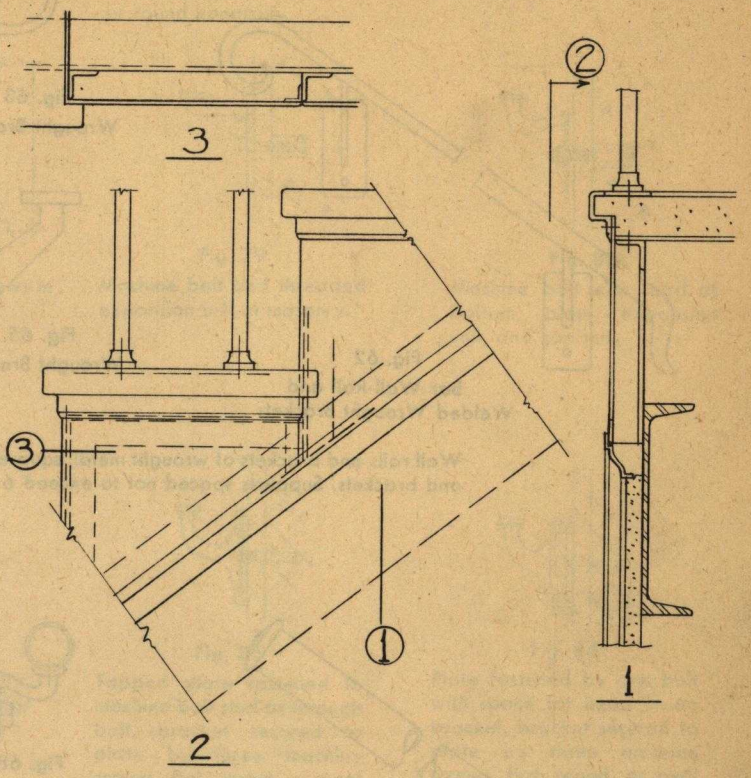


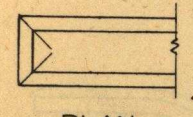
Fig. 57

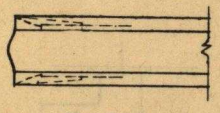


SCALE $1\frac{1}{2}$"=1'-0"

This construction may be used on one or both sides of a steel stair; upper part of flight may be built between walls with strings and treads in usual positions.

WALL RAILS—BRACKETS





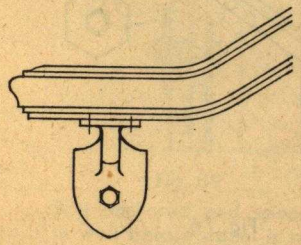


Fig. 58

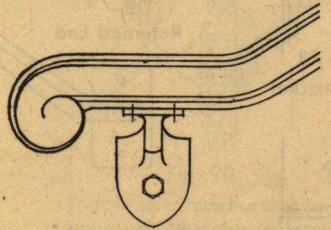


Fig. 59

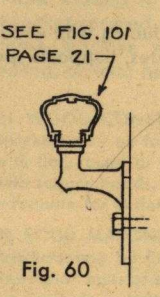
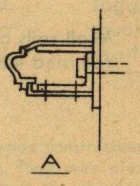
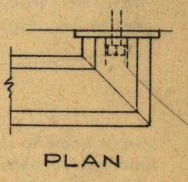


Fig. 60





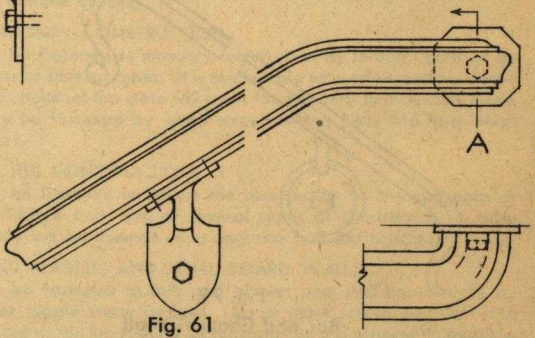


Fig. 61

Wall rails of formed or extruded sections with cast or wrought brackets. Ends may have mitered terminals, or may be returned to wall plates or may have special cast or wrought ornamental terminals. In any of these cases, rails may or may not have easements. Support brackets usually spaced 6 to 8 feet.

SCALE $1\frac{1}{2}$"=1'-0"

STAIRS

WALL RAILS—BRACKETS

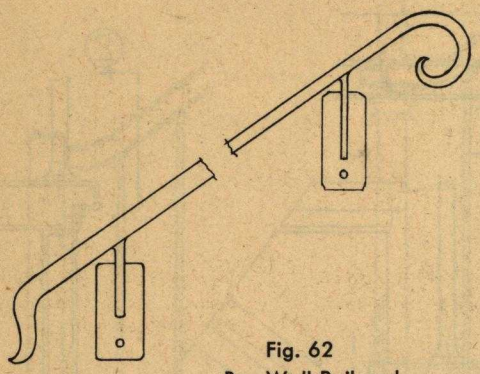


Fig. 62
Bar Wall-Rail and
Welded Wrought Brackets

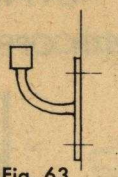


Fig. 63
Wrought Bracket

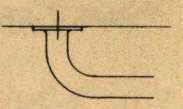


Fig. 64
Returned End

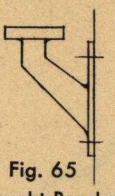


Fig. 65
Wrought Bracket

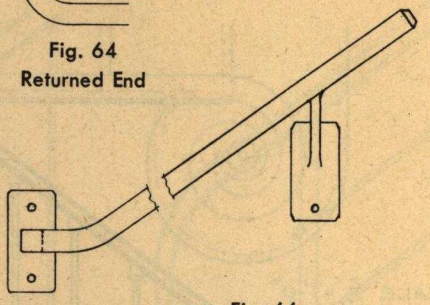


Fig. 66
Bar Wall Rail and
Welded Wrought Bracket

Wall rails and brackets of wrought metal, square or rectangular bars with forged ends and brackets. Supports spaced not to exceed 6 feet.

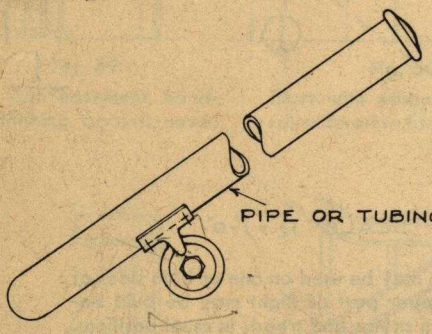


Fig. 67
Pipe Wall Rail and
Cast Bracket

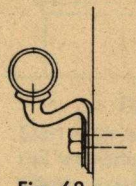


Fig. 68
Cast Bracket

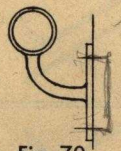


Fig. 70
Wrought Bracket

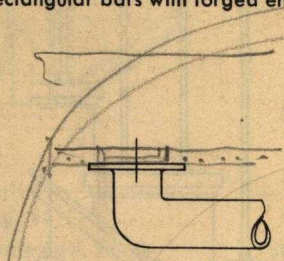


Fig. 69
Returned End

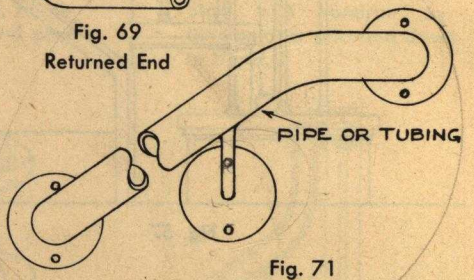


Fig. 71
Pipe Wall Rail and
Welded Wrought Bracket

Wall rails of pipe or tubing with wrought or cast brackets. Ends may be closed or be returned into wall plates. Supports spaced not to exceed 8 feet.

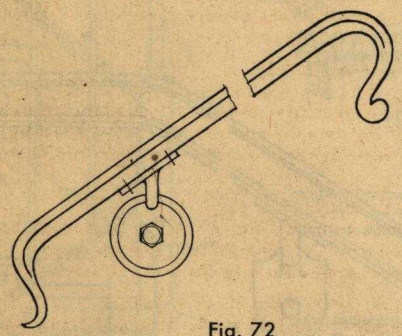


Fig. 72
Bar and Channel Wall
Rail and Cast Bracket

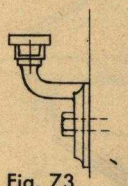


Fig. 73
Cast Bracket

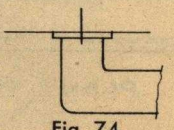


Fig. 74
Returned End

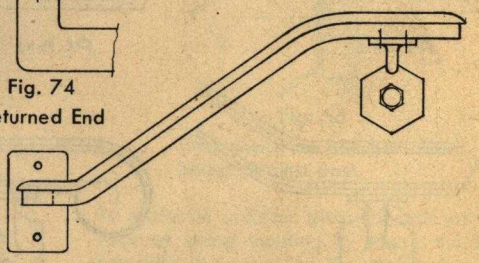


Fig. 76
Bar and Channel Wall
Rail and Wrought Bracket

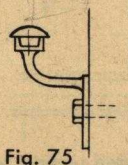


Fig. 75
Wrought Bracket

Wall rails of bars placed over channels, with wrought or cast brackets. Ends may be forged or returned into wall plates. Supports spaced not to exceed 7 feet.

SCALE $1\frac{1}{2}$" = 1'-0"

STAIRS

WALL RAIL BRACKET FASTENINGS

The style of handrail brackets shown on this page are for the purpose of indicating types of fastenings. Fabricators have similar patterns suitable for use in connection with the various methods of fastenings shown. Brackets are obtainable for either flat bottom or round handrails.

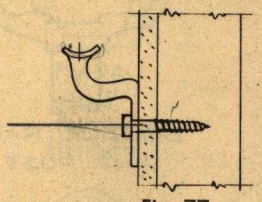


Fig. 77
Lag bolt in wood.

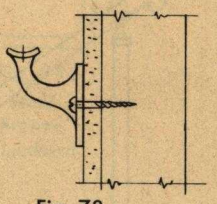


Fig. 78
Two or more wood screws in wood.

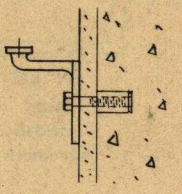


Fig. 79
Machine bolt and threaded expansion unit in masonry.

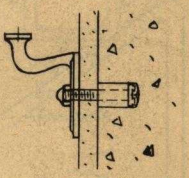


Fig. 80
Machine bolt with head at bottom, plain expansion unit, and cap nut.

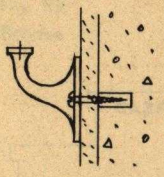


Fig. 81
Wood screws in fiber plugs or lead anchors.

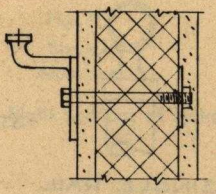


Fig. 82
Through bolt in masonry, with nut and washer on far side.

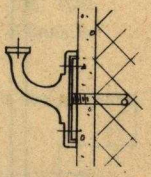


Fig. 83
Tapped plate fastened to machine bolt stud or through bolt, bracket secured to plate by three machine screws, flat; round, or oval head.

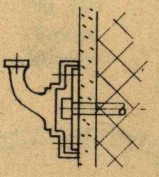


Fig. 84
Plate fastened by one bolt with space for head inside bracket, bracket secured to plate by three machine screws, flat, round, or oval head.

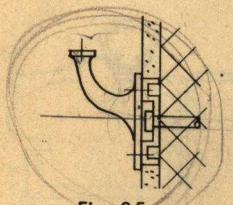


Fig. 85
Special casting fastened to rough wall by one bolt, bracket secured to casting by three machine screws, flat round, or oval head.

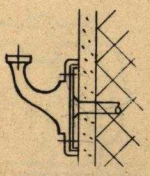


Fig. 86
Plate fastened by one flat head bolt, bracket secured to plate by three machine screws, flat, round, or oval head.

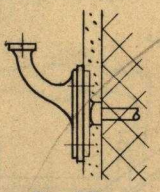


Fig. 87
Plate welded to bolt head, bracket secured to plate by three machine screws, flat, round, or oval head.

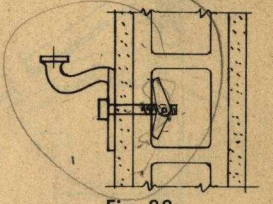


Fig. 88
Toggle in hollow tile with square, hexagon or round head bolt.

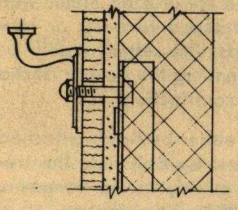


Fig. 89
Bolt anchored and spaced in wall before panel is set; bracket secured with cap nut. (See page 8)

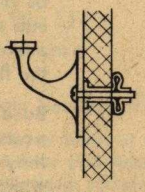


Fig. 90
Toggle screw anchor through panel or through plaster, two per bracket.

IN WOOD CONSTRUCTION:
Brackets may be fastened to wood construction by means of wood screws, with flat, round or oval heads. They may also be fastened by lag bolts with square heads, using one bolt per bracket. Wood backing should be adequate for uniform spacing.

IN SOLID MASONRY CONSTRUCTION:
Brackets may be fastened to masonry construction by through bolts or by expansion bolts of several types. It is preferable to use brackets designed for one bolt, as bolts set too close will crack the masonry and become loose. They also may be fastened by wood screws or lag bolts into fiber plugs or lead anchors.

IN HOLLOW TILE CONSTRUCTION:
Brackets may be fastened to hollow tile construction by through bolts or toggle bolts. Toggle bolts are of several types of construction. A more secure fastening will be assured using only one bolt per bracket.

ON LATH AND PLASTER, AND WALL BOARD WALLS:
Brackets may be fastened to lath and plaster and wall board walls by toggle bolts or toggle screw anchors. Two or more screws may be used per bracket, and should be spaced as far apart on the bracket as possible.

ON WALLS FACED WITH MARBLE OR OTHER PANELLING:
Where wall facings are not sufficiently rigid for securing brackets, bolts should be anchored into masonry backing before the setting of the facing, which must then be drilled for the bolts.

SCALE $1\frac{1}{2}$" = 1'-0"

STAIRS

CENTER RAILS

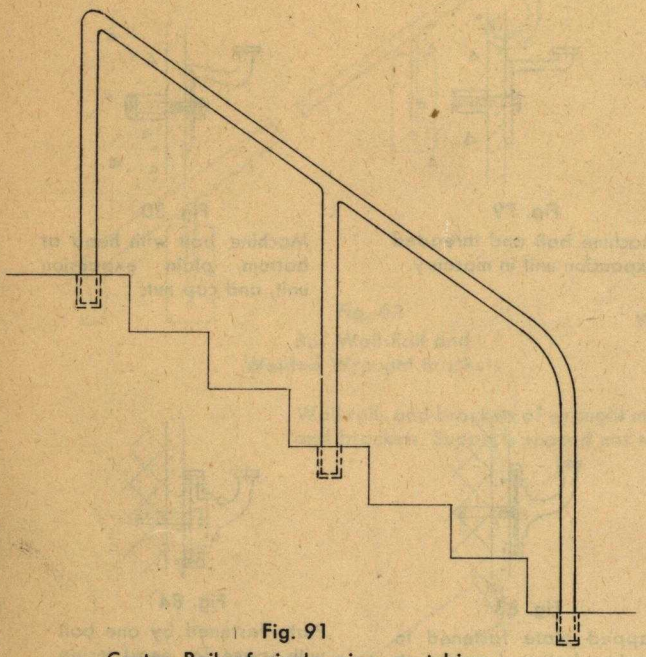


Fig. 91

Center Rail of single pipe or tubing welded to posts of like material.

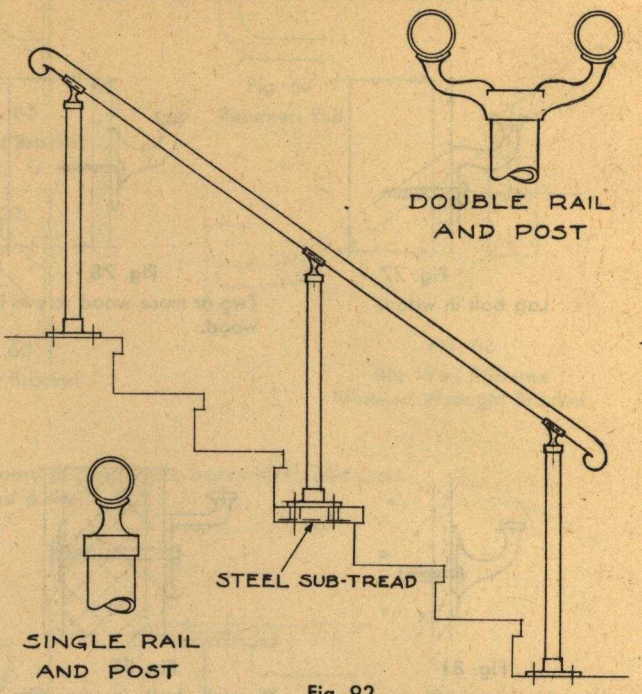


Fig. 92

Center Rail of single or double pipe, tubing or other section; ends closed with cast or formed ornament, supported by brackets on posts.

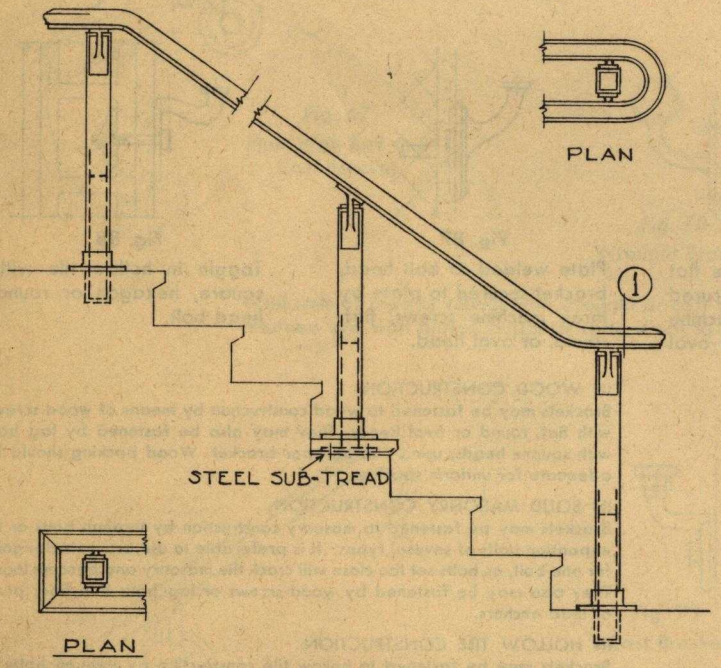
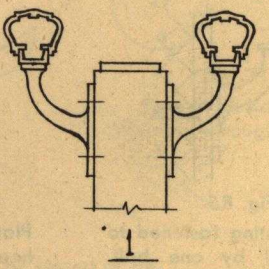


Fig. 93

Center Rail of two molded handrail sections with easements and returned ends, mitered or rounded, and supported by brackets on posts.



SCALE 1½"=1'-0"

Center rails are used on wide stairs, regulations in various localities differing with regard to the maximum stair width before center rails are required.

Center rails may be of ferrous or non-ferrous metals and may be constructed either with single or double rails attached to posts or newels set into the stair treads. The setting should be rigid, preferably by extending the post or anchoring to the floor or tread construction.

Base flanges may either be firmly attached to the posts, and anchored by bolts into the treads, or they may be used merely as slip flanges on posts which are anchored by other means.

Posts of double center rails may extend above the rails for preventing children from sliding the rails.

SPECIFY:

- **Locations.**
- **Size and Section of railing.**
- **Type of fastening.**
- **Metal and finish.**
- **Provide scale detail.**

STAIRS

HANDRAIL SECTIONS

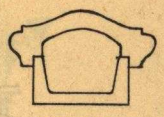


Fig. 94
Steel
Bronze
Aluminum

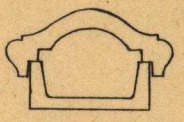


Fig. 95
Steel
Bronze
Aluminum

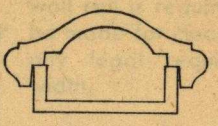


Fig. 96
Steel
Bronze
Aluminum

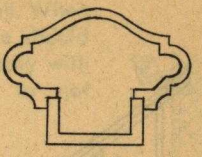


Fig. 97
Bronze
Aluminum

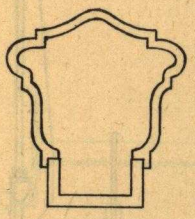


Fig. 98
Bronze

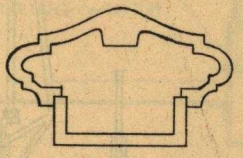


Fig. 99
Bronze
Aluminum

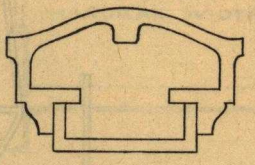


Fig. 100
Aluminum

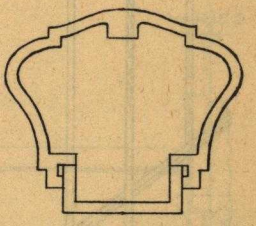


Fig. 101
Bronze
Aluminum

Eight Sections of Hand Rails with Ogee top surfaces.

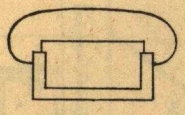


Fig. 102
Bronze
Aluminum

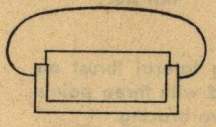


Fig. 103
Bronze
Aluminum

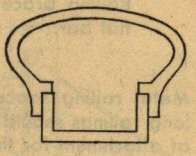


Fig. 104
Bronze
Aluminum

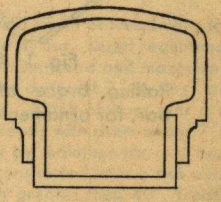


Fig. 105
Bronze

Four Sections of Hand Rails with Oval top surfaces.

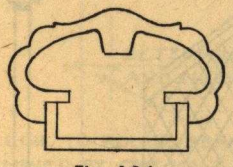


Fig. 106
Bronze

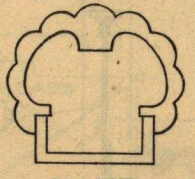


Fig. 107
Bronze

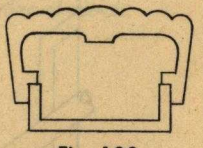


Fig. 108
Aluminum

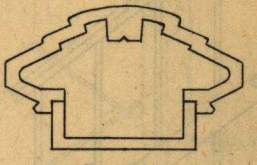


Fig. 109
Aluminum

Four Sections of Hand Rails with Fluted or Grooved top surfaces.

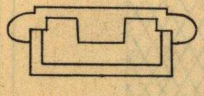


Fig. 110
Bronze

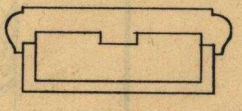


Fig. 111
Bronze

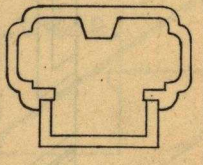


Fig. 112
Bronze
Aluminum

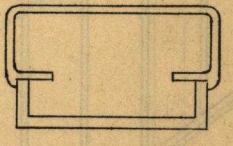


Fig. 113
Bronze
Aluminum

Four Sections of Hand Rails with Flat top surfaces.

The sections shown are typical of many widely employed types of hand rails. For complete information as to availability of these and numerous other rolled and extruded sections in steel, bronze, aluminum, nickel silver and other metals consult manufacturers' catalogues.

On projects requiring the development of original designs, the cost of special dies is not excessive when spread over a sufficient quantity. For small quantities, cost may be kept at a minimum by the use of available sections.

Stainless steel handrails are also obtainable in a limited number of shapes, formed from stainless steel sheets. Sections available are shown in producers or dealers catalogues. These are effectively used where very little bending is necessary.

Supports for handrails may be of channels or bars, of width and height to fit each particular case. They may be either hot rolled or of square root section preferably matching the metal in railings and brackets. Contrast in color between handrail and railing may thus be effected.

When it is impractical to bend or twist a handrail to the desired shape, castings are employed.

When specifying, indicate metal, finish, manufacturers' die number, and size and type of supporting channel.

SCALE $\frac{1}{2}$" = 1 INCH

STAIRS

RAILING BRACES—HIGH RAILINGS

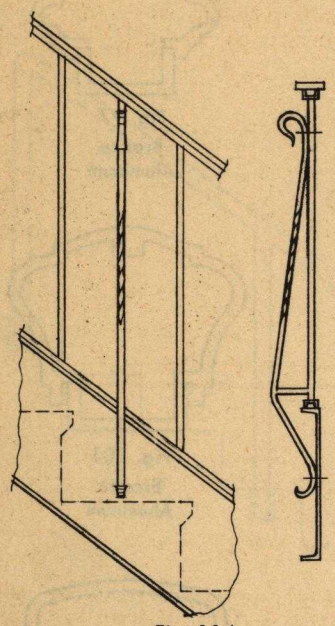


Fig. 114
Railing brace of wrought bar, for ornamental railings.

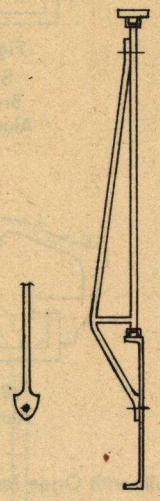


Fig. 115
Railing brace of square or flat bar.

Fig. 116
Railing brace of square or flat bar.

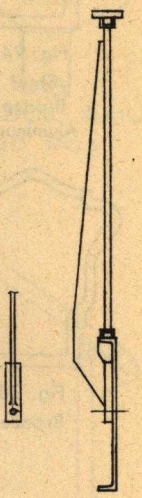


Fig. 117
Railing brace of flat bar on edge.

Metal railing braces for resisting lateral thrust on long railings should be constructed with three points of attachment for the most effective bracing.

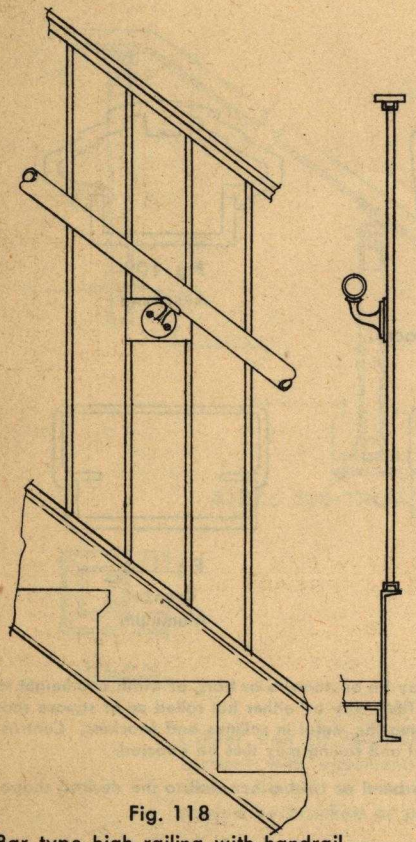


Fig. 118
Bar type high railing with handrail and bracket at usual height.

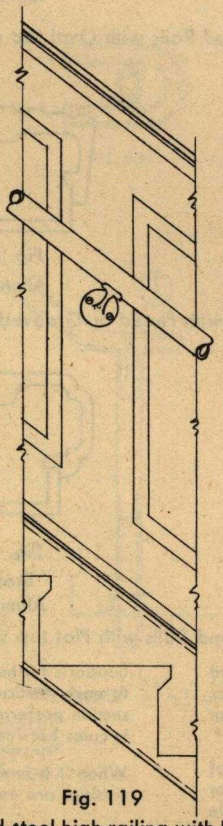


Fig. 119
Paneled steel high railing with handrail and bracket at usual height.

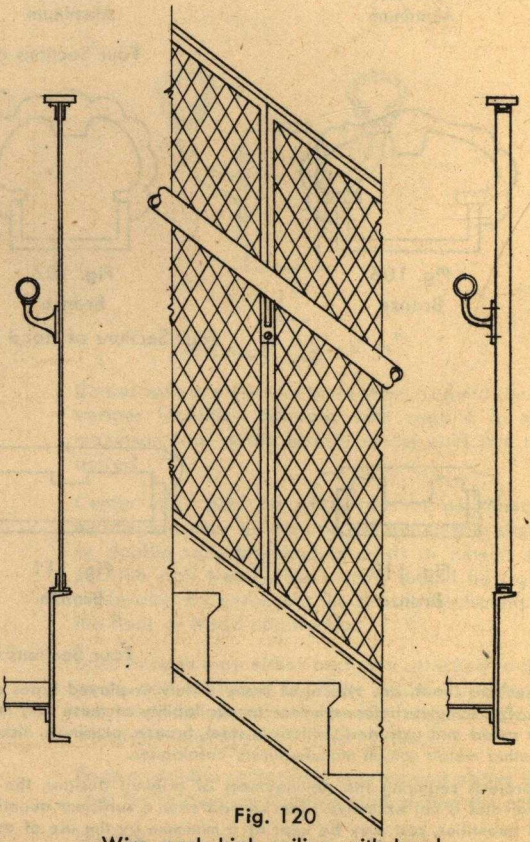


Fig. 120
Wire mesh high railing with handrail and bracket at usual height.

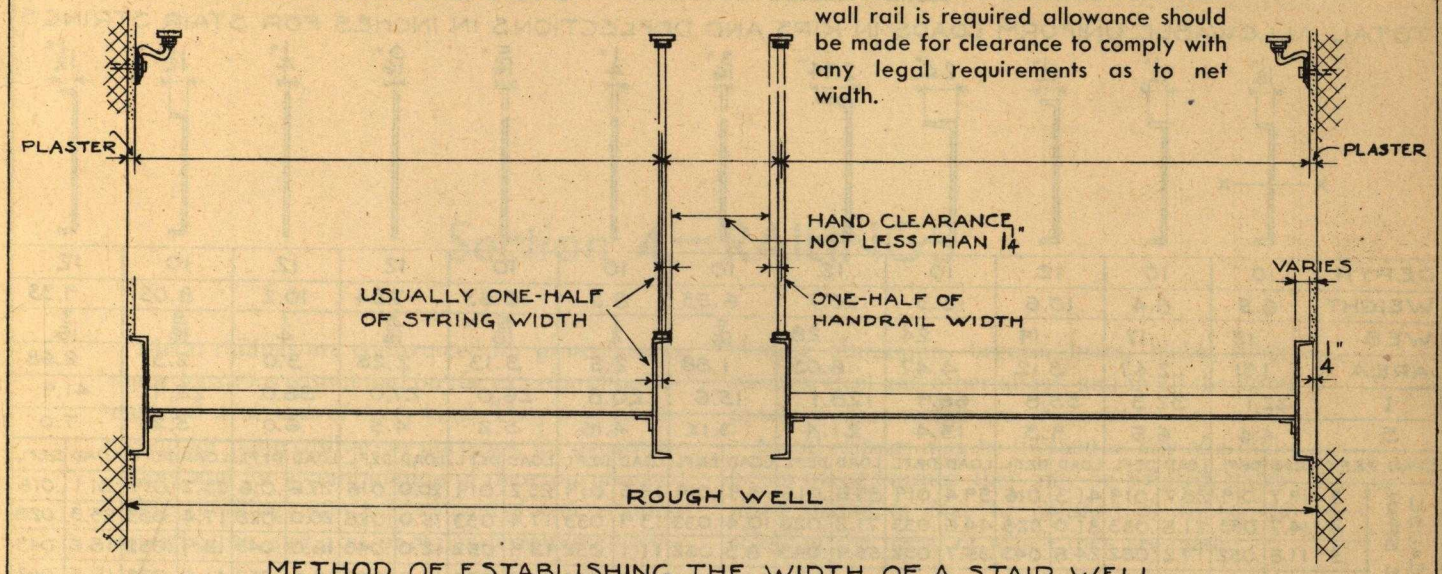
These railings may be constructed to extend from string to string or from string to ceiling, with doors at floors and landings as required. In Fig. 119 the protection above the railing may be of wire mesh or grilles.

SCALE $\frac{3}{4}$" = 1'-0"

STAIRS

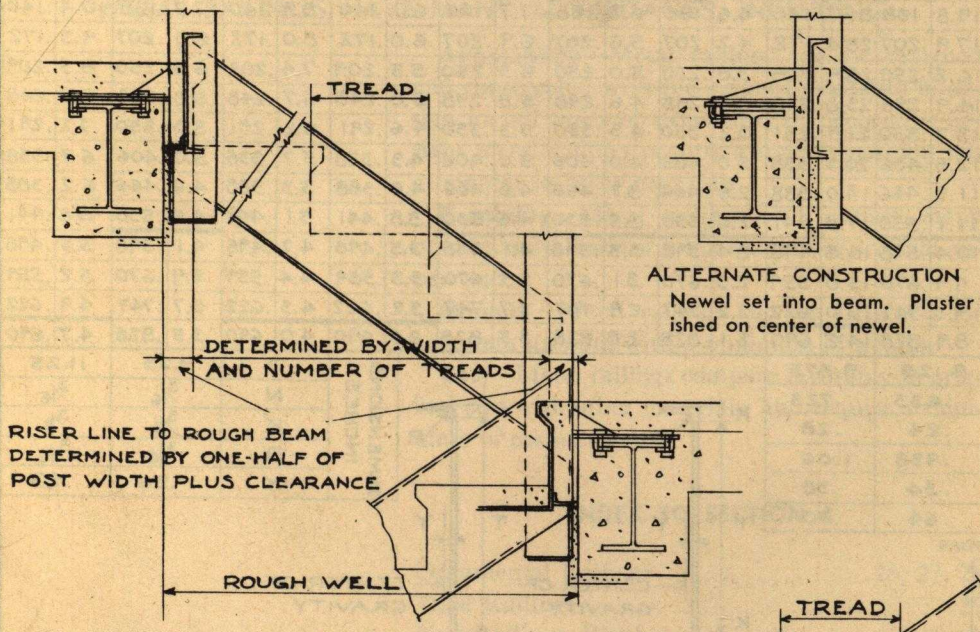
STAIR WELL DIMENSIONS

Width of stair is usually considered center line of rail to finished wall. When wall rail is required allowance should be made for clearance to comply with any legal requirements as to net width.

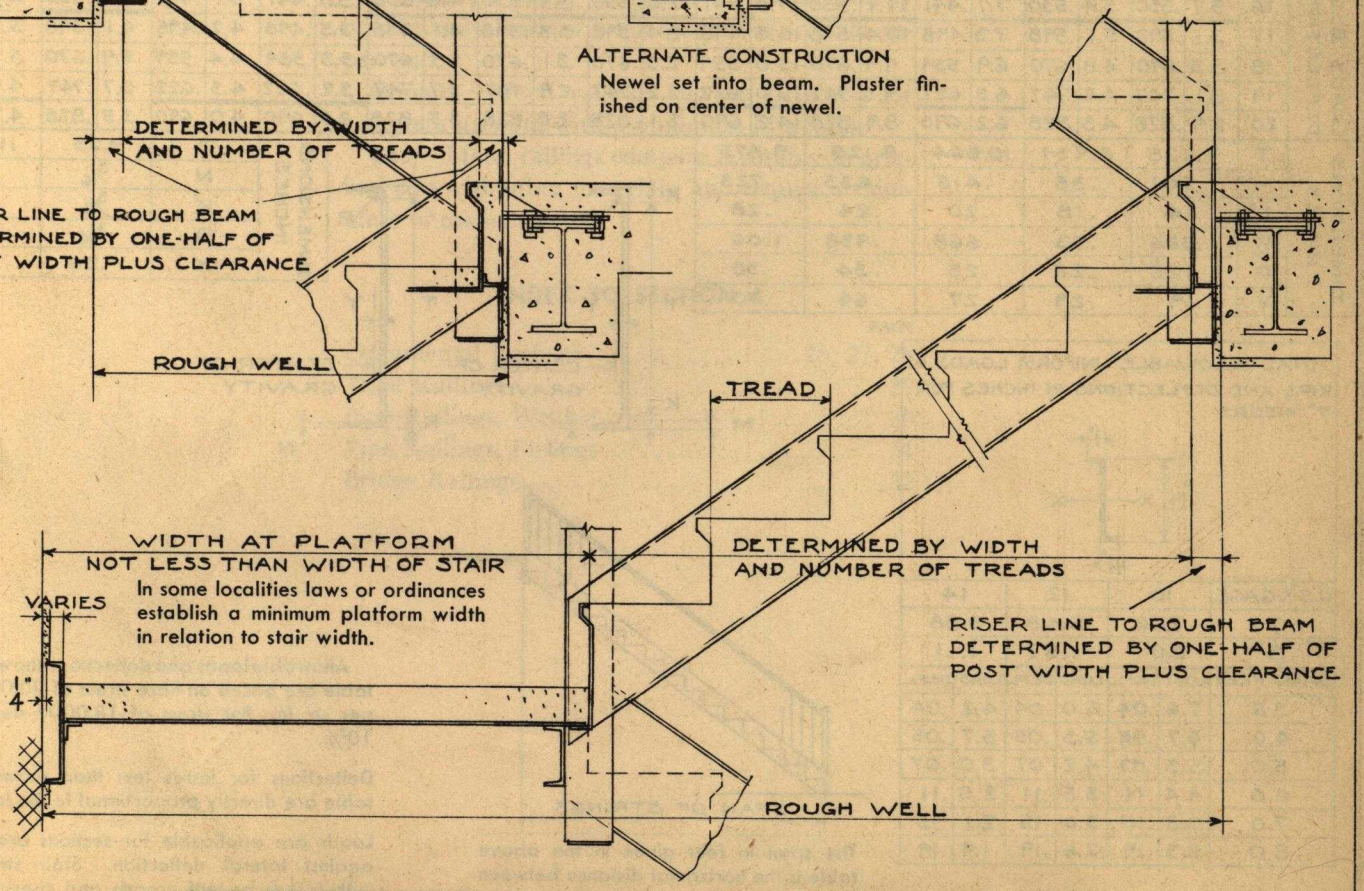


METHOD OF ESTABLISHING THE WIDTH OF A STAIR WELL

Height of riser and width of tread vary to fit the type of stair and its use. Legal requirements often limit the minimum tread and maximum rise. A tread of 10" and a rise of 7" to 7½" are considered average. Stairs of easy runs are often 10½" to 11" treads with risers under 7". Stairs used exclusively by maintenance and operating men are often constructed with a rise and tread to equal a pitch greater than 40°. Tread width is always face to face of riser.


TREAD
DETERMINED BY WIDTH AND NUMBER OF TREADS
RISER LINE TO ROUGH BEAM DETERMINED BY ONE-HALF OF POST WIDTH PLUS CLEARANCE
ROUGH WELL

ALTERNATE CONSTRUCTION
Newel set into beam. Plaster finished on center of newel.

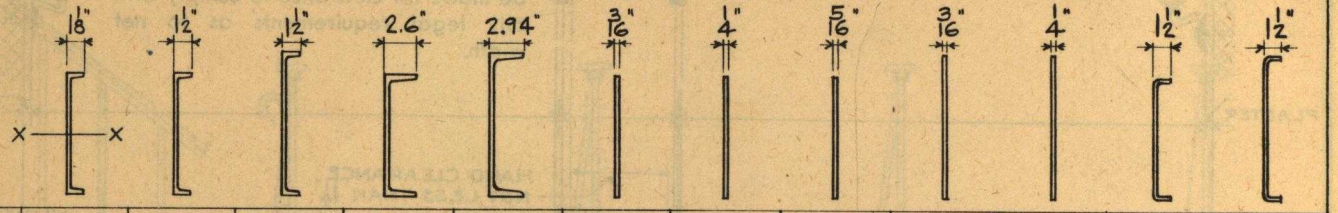

TREAD
WIDTH AT PLATFORM NOT LESS THAN WIDTH OF STAIR
In some localities laws or ordinances establish a minimum platform width in relation to stair width.
VARIES
1 1/4"
DETERMINED BY WIDTH AND NUMBER OF TREADS
RISER LINE TO ROUGH BEAM DETERMINED BY ONE-HALF OF POST WIDTH PLUS CLEARANCE
ROUGH WELL

METHOD OF ESTABLISHING THE LENGTH OF A STAIR WELL

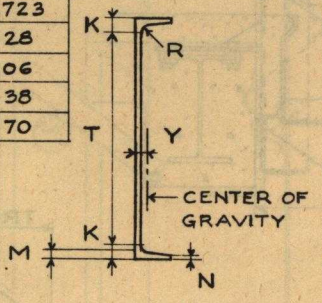
STAIRS

LOAD TABLES—STRINGS—RISERS

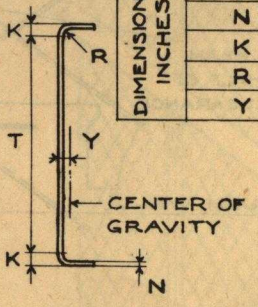
TOTAL ALLOWABLE UNIFORM LOADS IN KIPS AND DEFLECTIONS IN INCHES FOR STAIR STRINGS



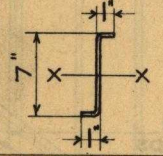
DEPTH		10		10		12		10		12		10		10		10		12		12		10		12	
WEIGHT		6.5		8.4		10.6		15.3		20.7		6.53		8.5		10.63		7.84		10.2		8.03		9.33	
WEB		.15		.17		.19		.24		.28		3/16		1/4		5/16		3/16		1/4		3/16		3/16	
AREA		1.91		2.47		3.12		4.47		6.03		1.88		2.5		3.13		2.25		3.0		2.3		2.68	
I		22.1		32.3		55.8		66.9		128.1		15.6		20.8		26.0		27.0		36.0		25.9		41.9	
S		4.4		6.5		9.3		13.4		21.4		3.12		4.16		5.2		4.5		6.0		5.2		7.0	
SPAN FEET		LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.
LOADS BELOW HEAVY LINE WILL CAUSE DEFLECTIONS EXCEEDING 1/360 OF THE SPAN.	3	19.7	.019	28.7	.019	41.3	.016	59.4	.019	89.5	.016	13.9	.019	18.5	.019	23.2	.019	20.0	.016	27.6	.016	23.2	.019	31.1	.016
	4	14.7	.033	21.5	.033	31.0	.028	44.6	.033	71.2	.028	10.4	.033	13.9	.033	17.4	.033	15.0	.028	20.0	.028	17.4	.033	23.3	.028
	5	11.8	.052	17.2	.052	24.8	.043	35.7	.052	56.9	.043	8.3	.052	11.1	.052	13.9	.052	12.0	.043	16.0	.043	13.9	.052	18.6	.043
	6	9.8	.074	14.3	.074	20.7	.062	29.8	.074	47.4	.062	6.9	.074	9.3	.074	11.6	.074	10.0	.062	13.3	.062	11.6	.074	15.5	.062
	7	8.4	.101	12.3	.101	17.7	.084	25.4	.101	40.7	.084	5.9	.101	7.9	.101	9.9	.101	8.6	.084	11.5	.084	9.9	.101	13.3	.084
	8	7.4	.132	10.7	.132	15.5	.110	22.3	.132	35.6	.110	5.2	.132	6.9	.132	8.7	.132	7.5	.110	10.0	.110	8.7	.132	11.7	.110
	9	6.6	.168	9.6	.168	13.8	.140	19.8	.168	31.7	.140	4.6	.168	6.2	.168	7.7	.168	6.7	.140	8.9	.140	7.7	.168	10.4	.140
	10	5.9	.207	8.6	.207	12.4	.172	17.9	.207	28.4	.172	4.2	.207	5.6	.207	6.9	.207	6.0	.172	8.0	.172	6.9	.207	9.3	.172
	11	5.4	.250	7.8	.250	11.3	.209	16.2	.250	25.9	.209	3.8	.250	5.0	.250	6.3	.250	5.5	.209	7.4	.209	6.3	.250	8.5	.209
	12	4.9	.298	7.2	.298	10.3	.248	14.9	.298	23.8	.248	3.5	.298	4.6	.298	5.8	.298	5.0	.248	6.7	.248	5.8	.298	7.8	.248
	13	4.5	.350	6.6	.350	9.5	.291	13.7	.350	21.9	.291	3.2	.350	4.3	.350	5.3	.350	4.6	.291	6.2	.291	5.3	.350	7.2	.291
	14	4.2	.406	6.1	.406	8.9	.338	12.8	.406	20.3	.338	3.0	.406	4.0	.406	5.0	.406	4.3	.338	5.7	.338	5.0	.406	6.7	.338
	15	3.9	.466	5.7	.466	8.3	.388	11.9	.466	19.0	.388	2.8	.466	3.7	.466	4.6	.466	4.0	.388	5.3	.388	4.6	.466	6.2	.388
	16	3.7	.530	5.4	.530	7.7	.441	11.1	.530	17.8	.441	2.6	.530	3.5	.530	4.3	.530	3.8	.441	5.1	.441	4.3	.530	5.8	.441
	17	3.5	.598	5.1	.598	7.3	.498	10.4	.598	16.8	.498	2.4	.598	3.3	.598	4.1	.598	3.5	.498	4.7	.498	4.1	.598	5.5	.498
	18	3.3	.670	4.8	.670	6.9	.559	9.9	.670	15.8	.559	2.3	.670	3.1	.670	3.9	.670	3.3	.559	4.4	.559	3.9	.670	5.2	.559
	19	3.1	.747	4.5	.747	6.5	.622	9.3	.747	15.0	.622	2.2	.747	2.9	.747	3.7	.747	3.2	.622	4.3	.622	3.7	.747	4.9	.622
	20	2.9	.828	4.3	.828	6.2	.690	8.9	.828	14.2	.690	2.1	.828	2.8	.828	3.5	.828	3.0	.690	4.0	.690	3.5	.828	4.7	.690
DIMENSIONS INCHES	T	9.228		8.934		10.664		8.125		9.875															
	M	.261		.38		.418		.633		.723															
	N	.14		.18		.20		.24		.28															
	K	.386		.63		.668		.938		1.06															
	R	.125		.25		.25		.34		.38															
	Y	.19		.29		.27		.64		.70															



DIMENSIONS INCHES			
	T	9.25	11.25
	N	3/16	3/16
	K	3/8	3/8
	R	3/16	3/16
	Y	.26	.23

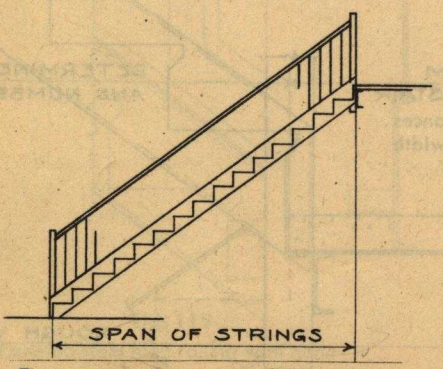


TOTAL ALLOWABLE UNIFORM LOADS IN KIPS AND DEFLECTIONS IN INCHES FOR 7" RISERS



U.S.S. GAGE		10		12		14	
I		7.02		5.48		3.88	
S		2.0		1.57		1.11	
SPAN FEET		LOAD	DEFL.	LOAD	DEFL.	LOAD	DEFL.
	3.5	7.6	.04	6.0	.04	4.2	.04
	4.0	6,7	.05	5.3	.05	3.7	.05
	5.0	5.3	.07	4.2	.07	3.0	.07
	6.0	4.4	.11	3.5	.11	2.5	.11
	7.0	3.8	.15	3.0	.15	2.1	.15
	8.0	3.3	.19	2.6	.19	1.9	.19

I = MOMENT OF INERTIA
S = SECTION MODULUS
} AXIS X–X



The span in feet given in the above table is the horizontal distance between supports.

Allowable loads and deflections shown in table are based on fibre stress of 20,000# per sq. in. For stress of 18,000# deduct 10%.

Deflections for loads less than shown in table are directly proportional to the load.

Loads are applicable for sections braced against lateral deflection. Stair strings with treads or with treads and risers are considered laterally braced.

Section 4—RAILINGS

Metal railings are constructed for protection at many locations within and on the exterior of buildings and structures of every kind. They may be designed for plain utilitarian purposes, for ornamentation, and for a combination of these purposes.

Metal railings may be fabricated of steel, genuine wrought iron, cast iron, or of non-ferrous metals including aluminum, bronze, brass, nickel silver, stainless steel and other alloys, and in all the forms in which these metals are produced.

Metal railings may be finished in any of a number of metal finishes: they may be painted, galvanized, plated, or may be polished to display the colors of the metal of which they are made.

METAL RAILINGS HAVE MANY ADVANTAGES, INCLUDING:

Adaptability—Metal railings can be designed and constructed with the greatest flexibility of design for all types of structures. In decorative designs metal railings occupy a unique position not attainable in other materials.

Durability—Metal railings will outlast many other materials and will maintain their original appearance.

Strength—Metal railings can be designed for adequate strength with a minimum of weight.

Cost—Metal railings compare favorably in original cost with other materials, and require a minimum of maintenance.

INDEX TO SECTION 4

PAGE

Ornamental Railings.....26, 27, 28
Tube Railings.....29
Pipe Railings, Welded.....30
Pipe Railings, Fittings.....31
Bridge Railings.....32

RAILINGS

ORNAMENTAL RAILINGS

Ornamental railings may be constructed of ferrous or non-ferrous metals, or of a combination of metals, in both wrought or cast form.

Methods of attachment of railings to steps and floors vary. On wood, balusters may be fastened by base flanges and wood screws, or by screw studs in end of baluster where balusters are not welded but screwed at top; in these cases the base flanges are of slip type. On masonry, balusters may extend into steps and floors, with slip type base flanges.

Finish of railings may be painted or have a mechanical finish, hammered, high-lighted, or polished, the metal supplying the color base. See **Part VII, Paints and Finishes.**

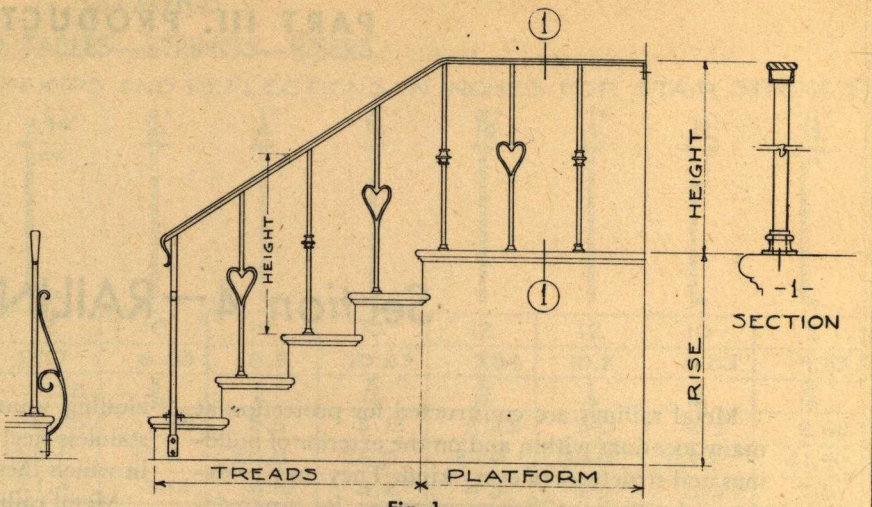


Fig. 1

Railing with balusters spaced one per tread and side brace at starting post.

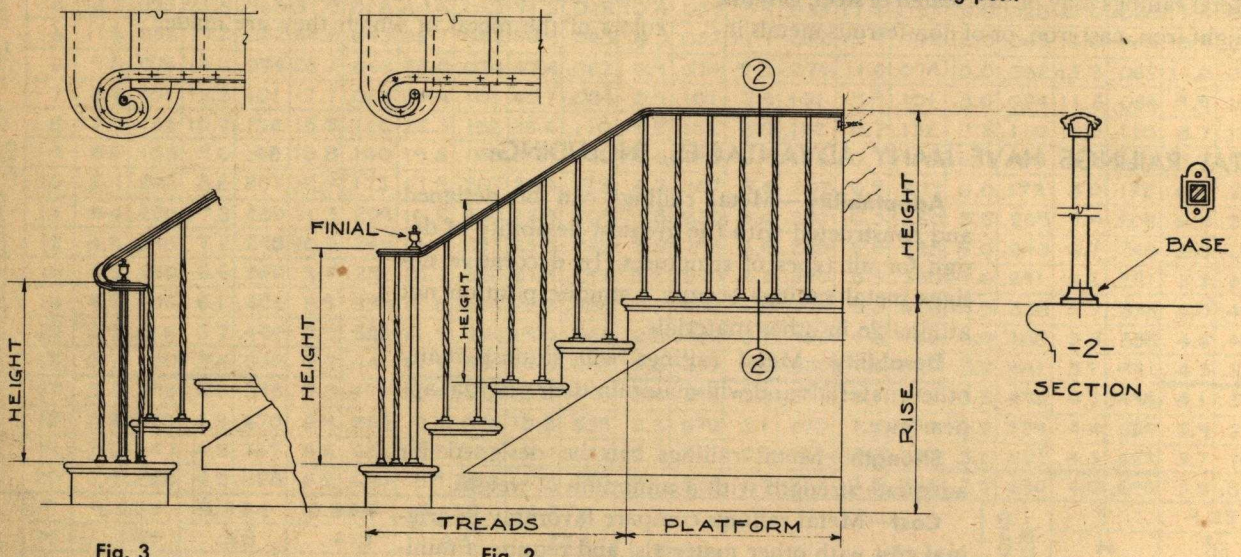


Fig. 3

Fig. 2

Railing with balusters spaced two per tread with starting volutes on first tread.

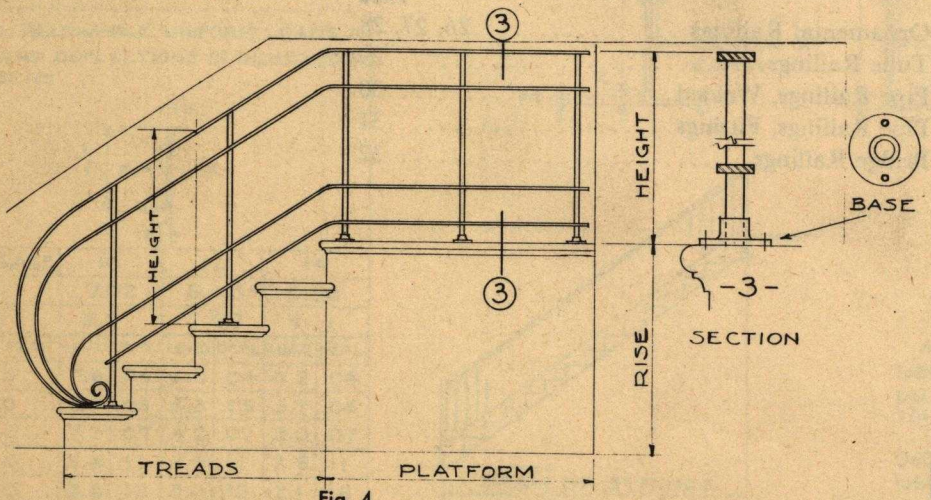


Fig. 4

Railing with longitudinal members supported on spaced posts, designed of sufficient strength to withstand deflection.

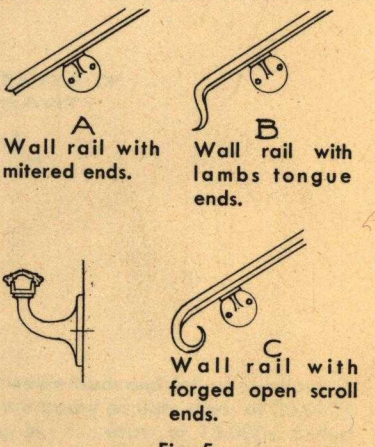


Fig. 5

Wall rails of several types, with sections matching step railings. For wall rails, brackets and fastenings, see pages 19 and 21.

ELEVATIONS - SCALE $\frac{3}{8}$" = 1'-0"

SECTIONS - SCALE $1\frac{1}{2}$" = 1'-0"

RAILINGS

ORNAMENTAL RAILINGS

Railings for decks, roofs, platforms and similar places may be constructed of ferrous or non-ferrous metal. The architect has a great latitude in the design of these railings.

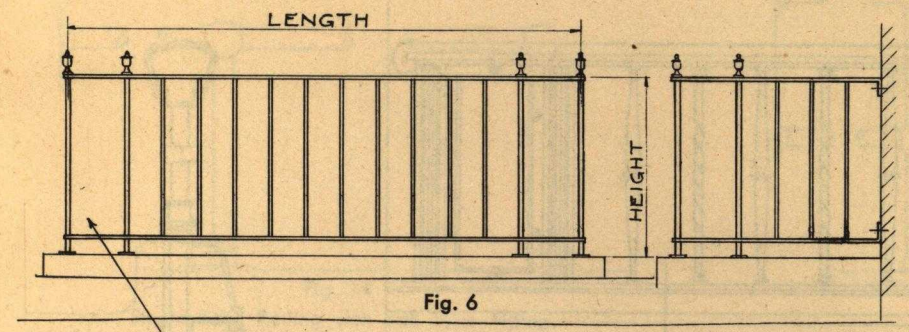


Fig. 6

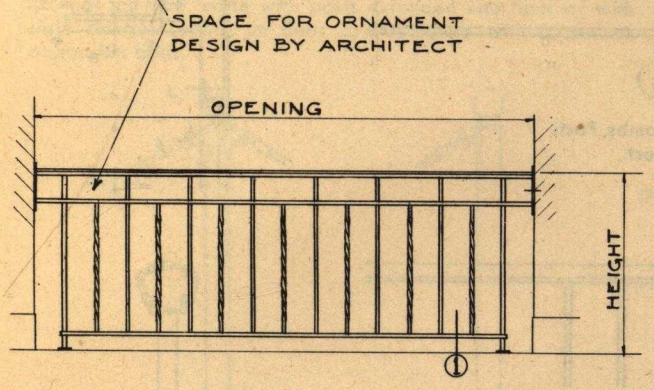


Fig. 7

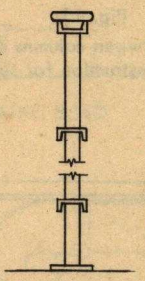


Fig. 6 and Fig. 7 indicate typical railings for decks, platforms, balconies, roofs and similar locations, adapted for residential, apartment or hotel construction.

These railings may be fastened with wood screws or lag bolts to wood, or with expansion bolts to masonry. On roofs or decks the setting of the post bases should be waterproofed.

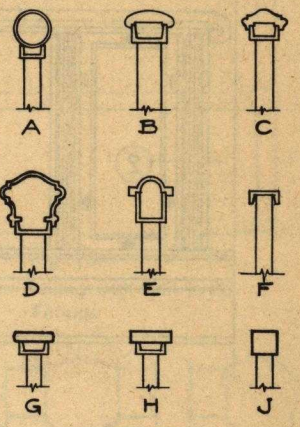


Fig. 8

Methods of constructing railing top members. For additional handrail sections see page 21.

SCALE $1\frac{1}{2}$" = 1'-0"

TO SPECIFY:

Give locations.
Indicate kind of metal.
Specify finish.
Give sizes of members.
Give height.
Provide scale details of ornaments, finials and bases.

Specify method of fastening, or have fabricator provide fastenings best suited to each condition.

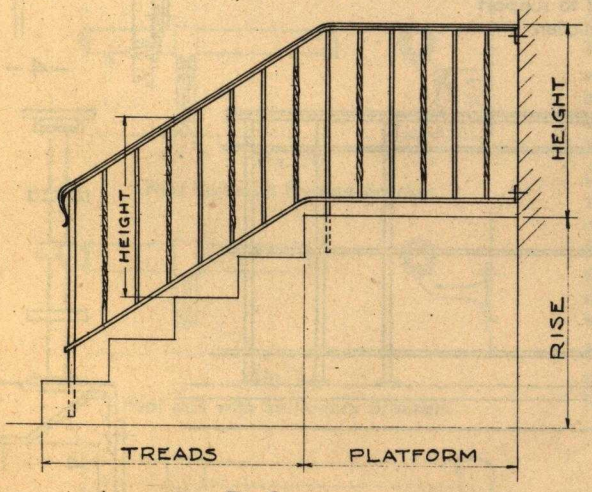


Fig. 9

Railing with balusters and bottom longitudinal member supporting balusters. Posts extending into masonry.

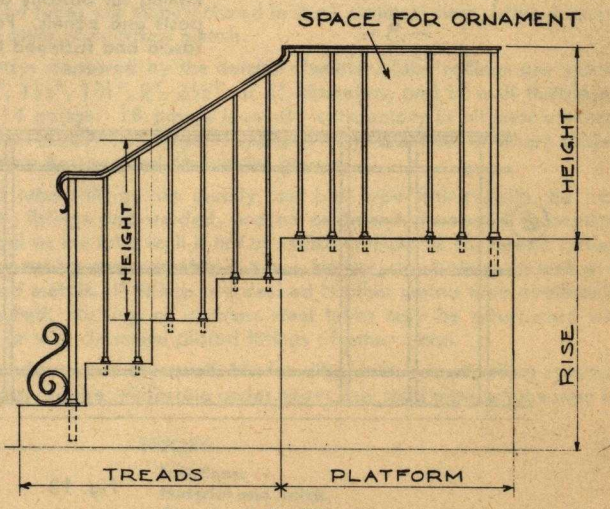


Fig. 10

Railing without bottom longitudinal member, each baluster set in masonry and fitted with slip flange or base. Masonry specifications should specify holes.

SCALE $\frac{3}{8}$" = 1'-0"

RAILINGS

ORNAMENTAL RAILINGS

Railings for balconies, mezzanines and similar places may be constructed of ferrous or non-ferrous metal or a combination of both in wrought or cast. The architect has great latitude in the design of this type of railing.

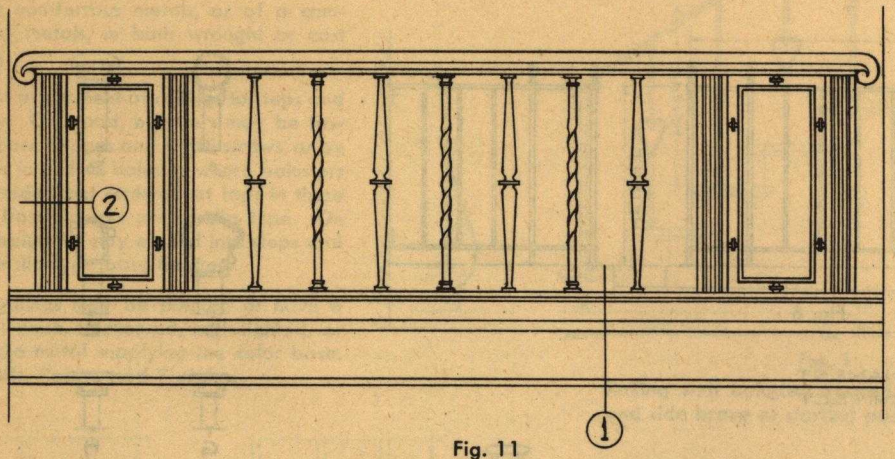
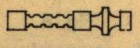


Fig. 11

Railing panels set between columns or jambs. Posts extended to floor construction for support.



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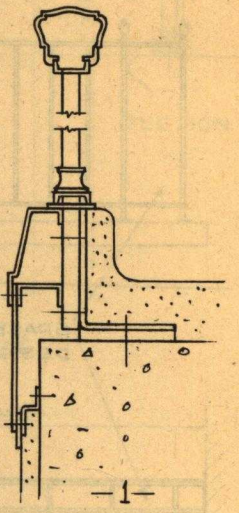

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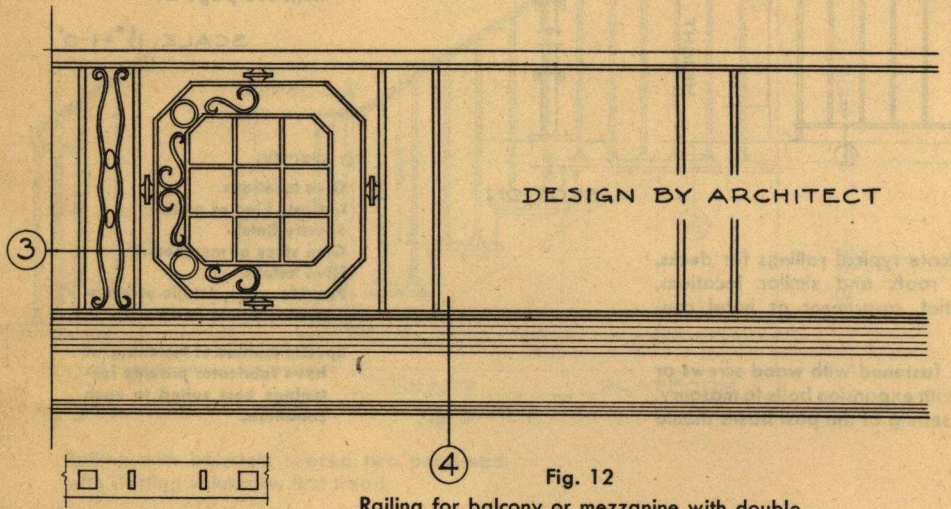

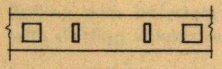

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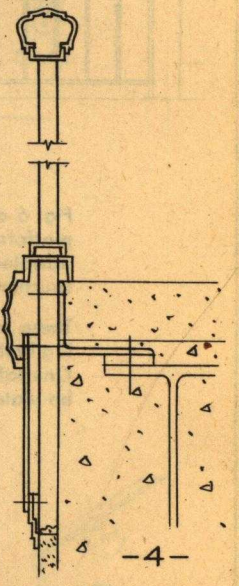
Fig. 12

Railing for balcony or mezzanine with double posts and panels. Posts extended to support fascia and fastened to floor construction.



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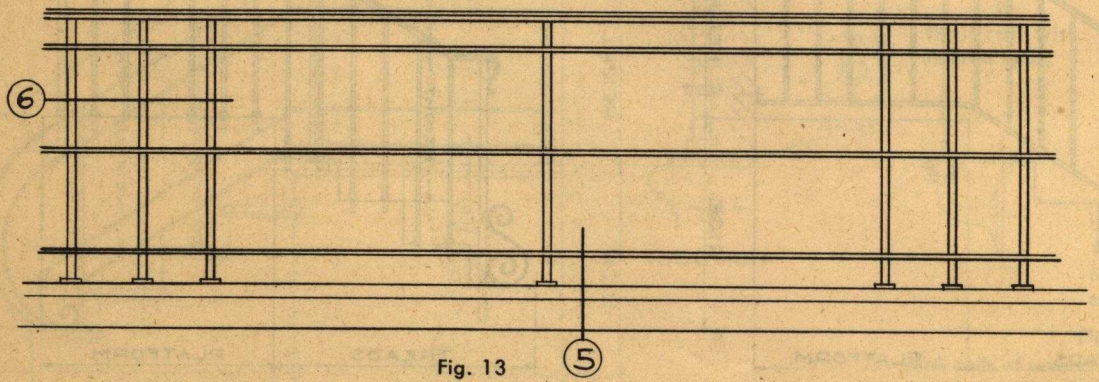
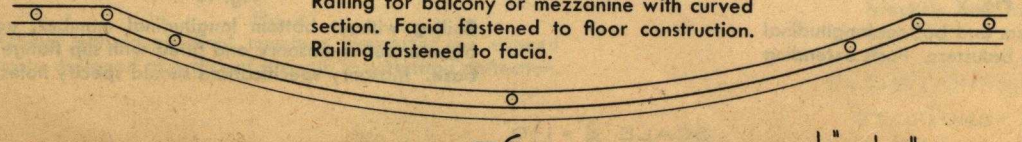


Fig. 13

Railing for balcony or mezzanine with curved section. Facia fastened to floor construction. Railing fastened to facia.



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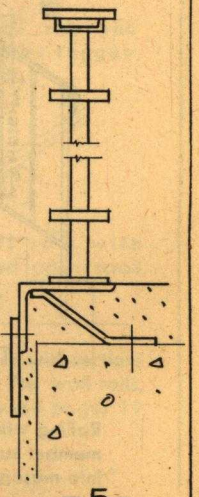

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SCALE $\frac{1}{2}$" = 1'-0"

SCALE $1\frac{1}{2}$" = 1'-0"

RAILINGS

TUBE RAILINGS

Tube railing can be designed in a variety of interesting and useful ways, the employment of metals of matching or contrasting colors providing versatile effects in theatres, court rooms, lobbies and other locations where this type of ornamental metal is particularly adaptable.

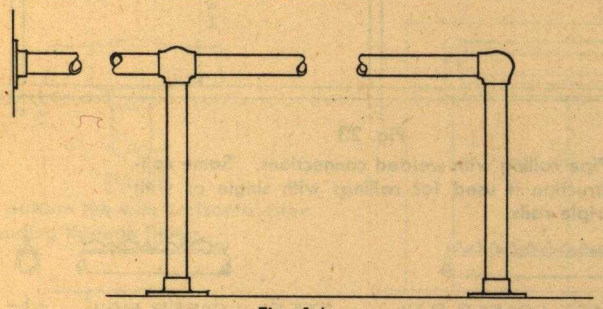


Fig. 14

Single Tube Railing with Ball Type Fittings

Railings may be made with posts extended into floor or with rigid flanges setting on floor and fastened with screws or expansion bolts.

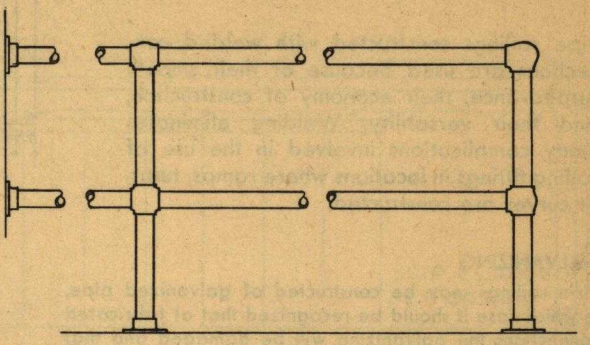


Fig. 15

Double Tube Railing with Ball Type Fittings

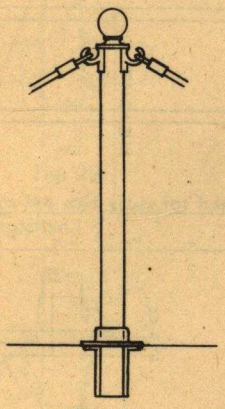


Fig. 16

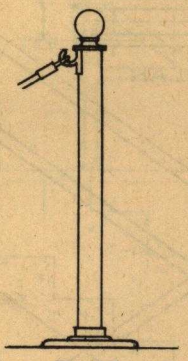


Fig. 17

Single Posts with Ball Caps and Hooks for Rope Railing. Removable post, Fig. 16, is constructed with metal socket set in floor, with a plug provided for the socket. Movable post, Fig. 17, free standing on floor, is constructed with large flat base of sufficient weight to hold post rigid.

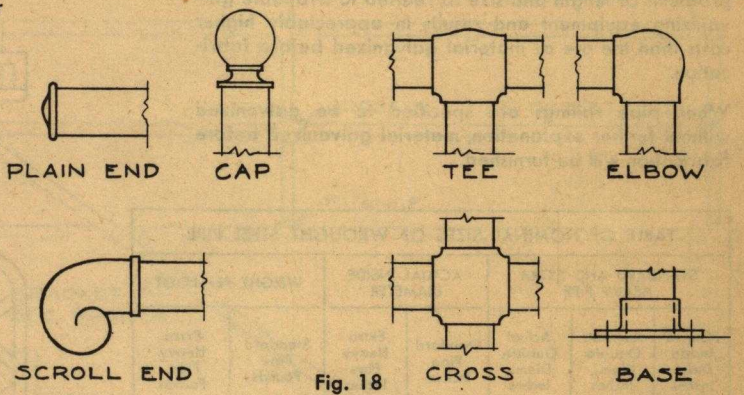


Fig. 18

Types of Fittings

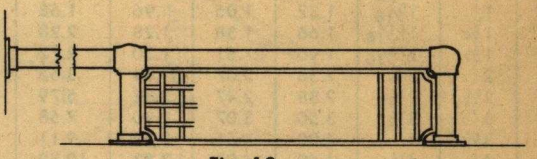


Fig. 19

Low Level Railing with or without Grille

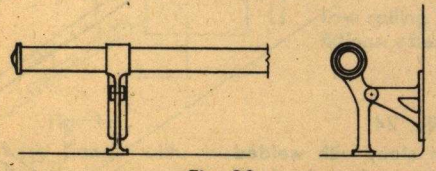


Fig. 20

Foot Rail with Pivoted Bracket

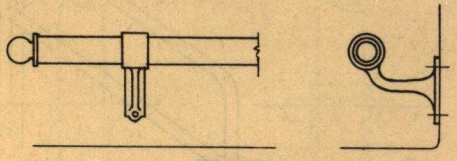


Fig. 21

Foot Rail with Stationary Brackets

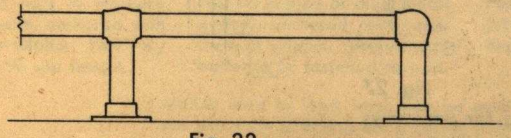


Fig. 22

Foot Rail with Stationary Posts

Railings of round tubes are manufactured in steel, stainless steel, brass, bronze, aluminum and other non-ferrous metals.

Tubes are always measured by the ***outside diameter.*** Tube railings are usually specified in 1″, 1½″, 1¾″, 2″, 2½″, or 3″ diameters, and in wall thicknesses of 18, 16 or 14 gauge. 18 gauge is usually satisfactory in all metals except aluminum which is usually 16 gauge. Railing of large diameter or where subject to heavy use may be specified of heavier gauge.

Connections of tube railings are usually cast ball type fittings with the tube slipped into the fittings and welded, brazed or pinned. Threaded connections are not practical as the tube wall is not of sufficient thickness for thread cutting. Fittings for tube railing are available in brass, bronze, or aluminum as well as in chromium plated metals. If fittings are desired in other metals their availability should be checked. Railings of stainless steel tubes may be constructed with welded joints, or with chromium plated fittings of other metal.

Base flanges and brackets are available for all usual types of railing construction. Where posts require reinforcing under heavy use, steel pipe or tube may be inserted.

SPECIFY:

- **Locations.**
- **Material and finish.**
- **Outside diameter and gauge of tube.**
- **Height.**
- **Method of fastening.**
- **Provide scale details, particularly of special connections or conditions.**

SCALE $\frac{3}{4}$" = 1'-0"

RAILINGS

PIPE RAILINGS—WELDED

Pipe railings constructed with welded connections are used because of their smooth appearance, their economy of construction, and their versatility. Welding eliminates many complications involved in the use of railing fittings in locations where ramps, turns, or curves are constructed.

GALVANIZING

Pipe railings may be constructed of galvanized pipe, in which case it should be recognized that at fabricated connections the galvanizing will be damaged and that these connections must be painted.

Galvanizing pipe railings after fabrication involves problems of length and size as related to available galvanizing equipment and results in appreciably higher costs than the use of material galvanized before fabrication.

When pipe railings are specified to be galvanized without further explanation, material galvanized before fabrication will be furnished.

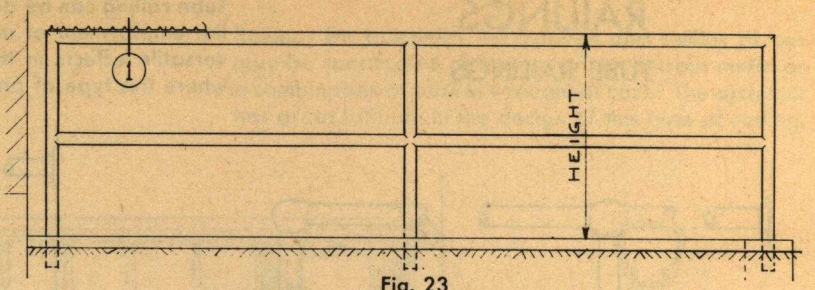


Fig. 23

Pipe railing with welded connections. Same construction is used for railings with single or with triple rails.

Loafer rail of steel or cast metal attached to top rail may be provided if specified.

TABLE OF NOMINAL SIZES OF WROUGHT STEEL PIPE

STANDARD AND EXTRA HEAVY PIPE			ACTUAL INSIDE DIAMETER		WEIGHT PER FOOT	
Nominal Inside Diam., Inches	Approx. Outside Diam., Inches	Actual Outside Diam., Inches	Standard Pipe Inches	Extra Heavy Pipe Inches	Standard Pipe Pounds	Extra Heavy Pipe Pounds
½	⅞	.84	.62	.55	.85	1.09
¾	1 1/16	1.05	.82	.74	1.13	1.47
1	1 5/16	1.32	1.05	.96	1.68	2.17
1 ¼	1 11/16	1.66	1.38	1.28	2.28	3.00
1 ½	1 15/16	1.90	1.61	1.50	2.72	3.63
2	2 3/8	2.38	2.07	1.94	3.65	5.02
2 ½	2 7/8	2.88	2.47	2.32	5.79	7.66
3	3 ½	3.50	3.07	2.90	7.58	10.25
3 ½	4	4.00	3.55	3.36	9.11	12.51
4	4 ½	4.50	4.03	3.83	10.79	14.98

Round pipe size is always designated by nominal inside diameter. Extra heavy pipe has the same outside diameter as standard pipe, the extra thickness being on the inside, therefor reducing the inside diameter of the pipe.
Pipe of genuine wrought iron, copper steel, stainless steel, or non-ferrous metal, produced in the above sizes, is made and specified in "iron pipe sizes."

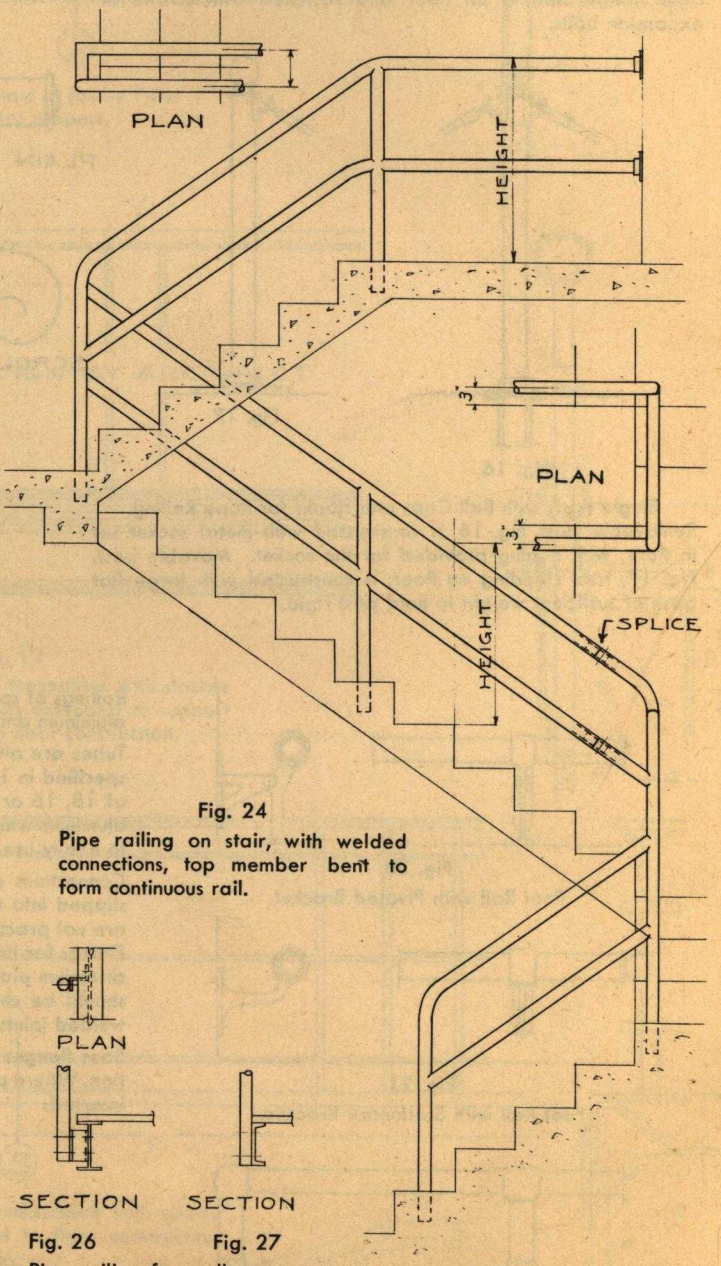


Fig. 24

Pipe railing on stair, with welded connections, top member bent to form continuous rail.

RECOMMENDED POST SPACING FOR PIPE RAILINGS	
Size of Pipe	Maximum Spacing
¾"	4'
1"	6'
1 ¼"	7'
1 ½"	8'
2"	9'
2 ½"	10'
3"	10'

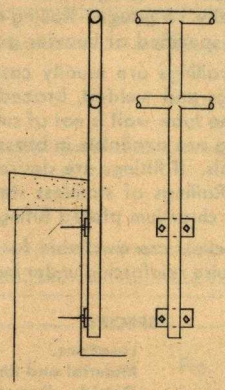


Fig. 25

Pipe railing for roof copings, parapets, or low walls, fastened with expansion or through bolts.

Fig. 26

Pipe railing for walkways bolted to steel framing.

Fig. 27

SCALE $\frac{3}{8}$" = 1'-0"

RAILINGS

PIPE RAILINGS—FITTINGS

Pipe railings may be constructed with ball pattern or plain pattern fittings. Connections may be threaded into the fittings or slipped in and pinned. In many cases both methods may be used. For pipe sizes and recommended post spacing see page 30.

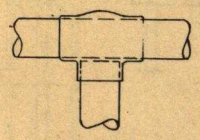


Fig. 28

Ball pattern tee with horizontal pipe extending through fitting.

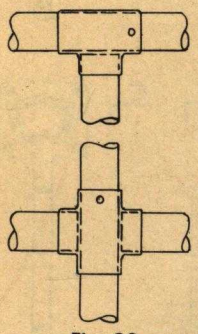


Fig. 29

Plain pattern tee and cross for horizontal construction.

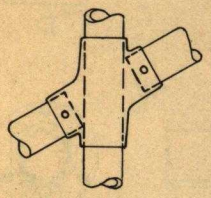


Fig. 30

Ball pattern or plain pattern cross for ramp construction. Used with tees, elbows and side outlet fittings, all often requiring special patterns to fit the angles of ramps and conditions of assembly.

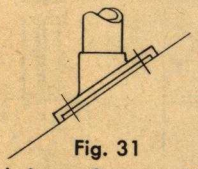
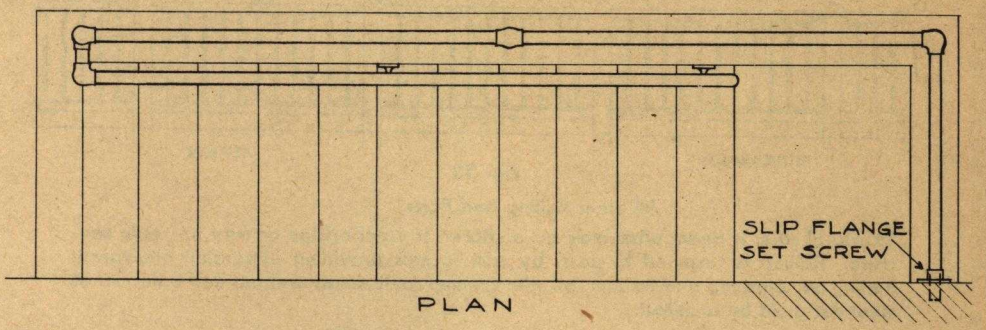


Fig. 31

Beveled base flange with raised lugs for adjustment to variation in pitch.



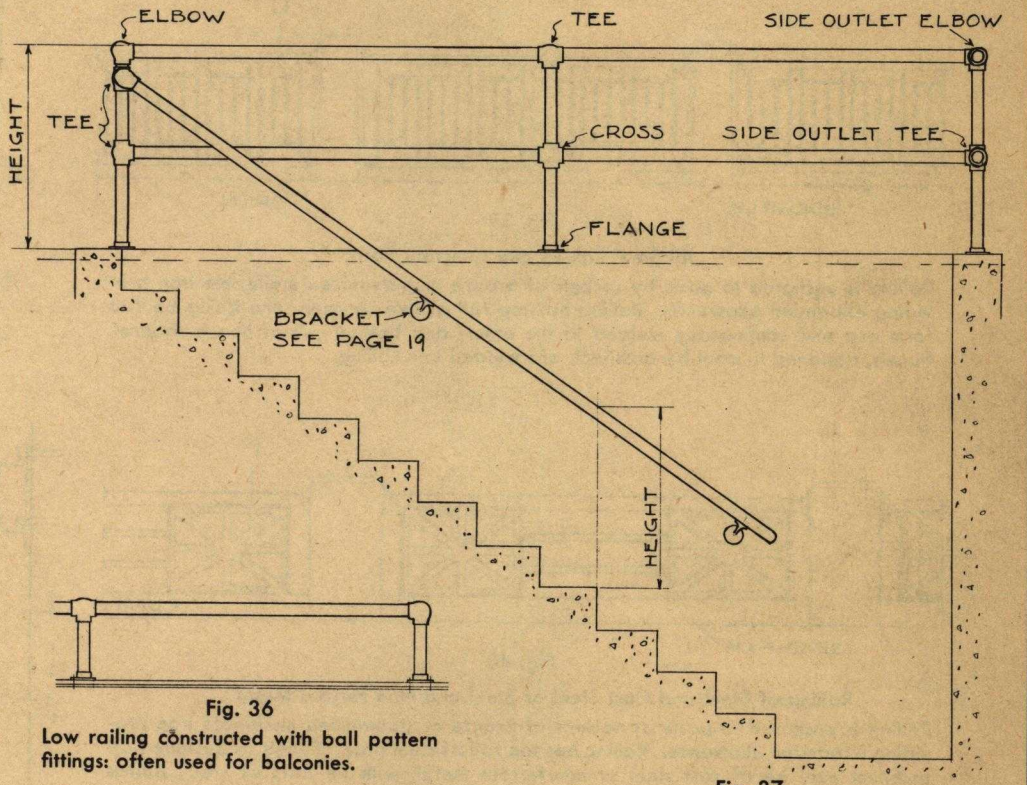


Fig. 36

Low railing constructed with ball pattern fittings: often used for balconies.

Fig. 37

Pipe rail constructed with ball pattern fittings: Posts fastened by any one of the methods indicated in Figs. 32, 33, 34, or 35.

SCALE $\frac{3}{8}$" = 1'-0"

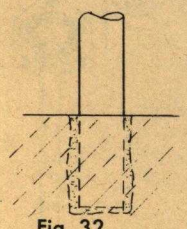


Fig. 32

Post set in hole in masonry without sleeve, anchored with concrete or sulphur. Post may be fitted with slip flange.

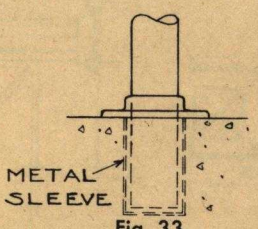


Fig. 33

Post set in pipe or sheet metal sleeve, anchored with concrete or sulphur. Flange may be loose or fastened to post.

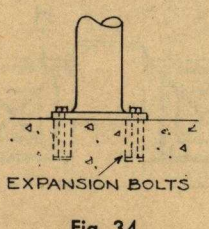


Fig. 34

Post welded to plate base and anchored by expansion bolts.

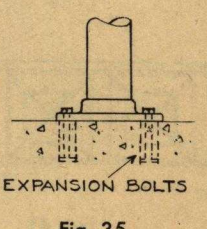


Fig. 35

Post threaded into screw flange and anchored by expansion bolts.

TO SPECIFY:

Give location.
Kind of metal and finish.
Size of pipe, always nominal inside diameter.
Method of fastening.

Molten lead or lead wool may be used for anchoring, where the tendency to flow is not a factor involving strength.

SCALE $1\frac{1}{2}$" = 1'-0"

RAILINGS

BRIDGE RAILINGS

Metal railings for bridges are desirable for appearance and utility, light in weight, strong and durable. They allow a maximum of vision and can be fabricated in ferrous and non-ferrous metal.

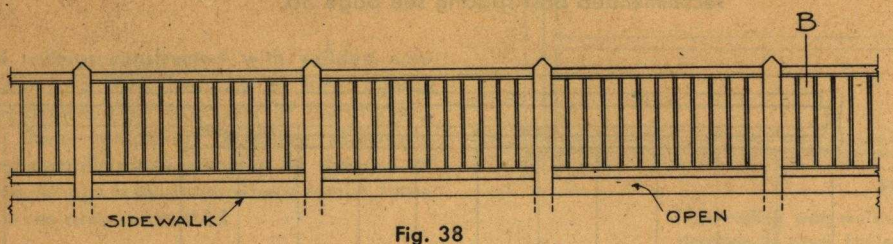
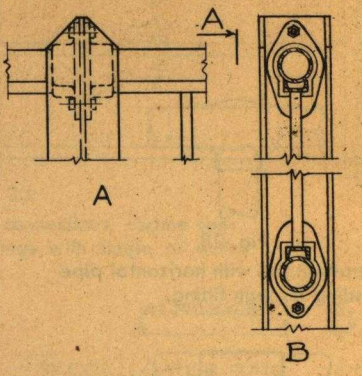


Fig. 38

All Steel Railing and Posts

Structural steel H beam posts may be anchored to steel bridge or may be set in concrete. Railing is fastened to posts by cast sockets providing expansion allowance. Railing has pipe top and bottom rail with channel continuously welded and balusters of steel designed by architect.



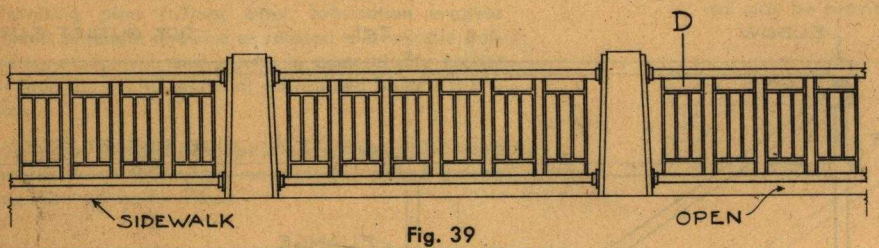
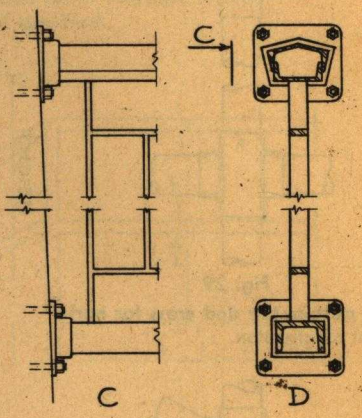


Fig. 39

All Steel Railing and Concrete Posts

Railing is anchored to posts by sockets of bronze or galvanized malleable iron providing expansion allowance. Railing has top rail of two channels, one being bent to form cap and continuously welded to the other; and bottom rail of heavy channel. Panels, designed in steel by architect, are welded into railing.



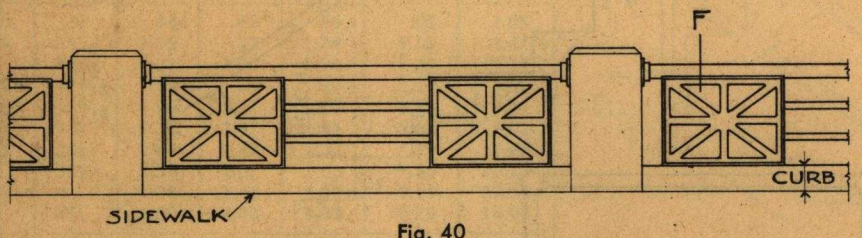
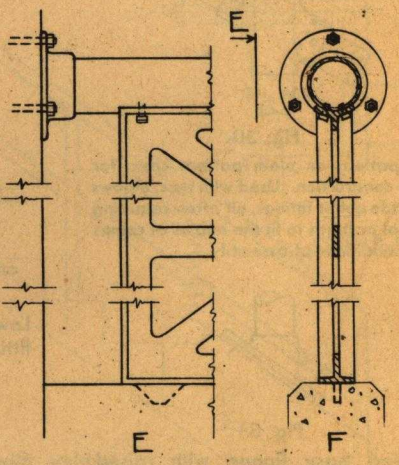


Fig. 40

Railing of Steel and Cast Steel or Steel and Non-Ferrous Metal

Railing is anchored to posts by sockets of bronze or galvanized malleable iron providing expansion allowance. Railing has top rail of steel pipe. Panels as designed by architect may be of cast steel or non-ferrous metal, with tie bars of steel, panels anchored to concrete curb.



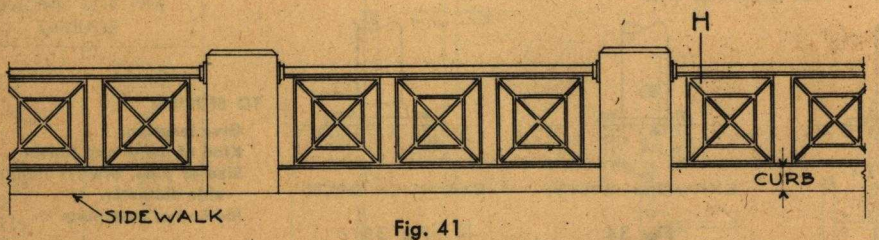
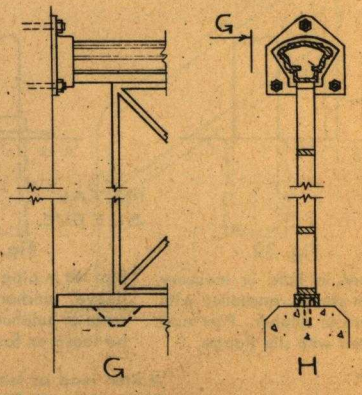


Fig. 41

Railing of Non-Ferrous Metal

Railing is anchored to posts by sockets of bronze or galvanized malleable iron providing expansion allowance. Railing has hand rail of extruded bronze, aluminum or other non-ferrous metal, and panels of non-ferrous metal as designed by architect.



SCALE $\frac{3}{16}$" = 1'-0"

SCALE $\frac{3}{4}$" = 1'-0"

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